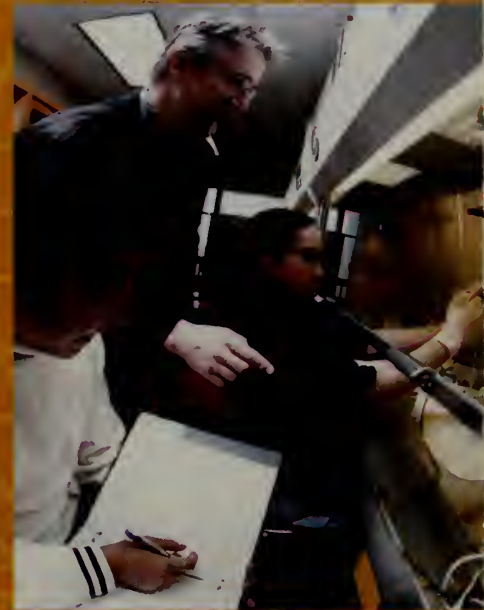
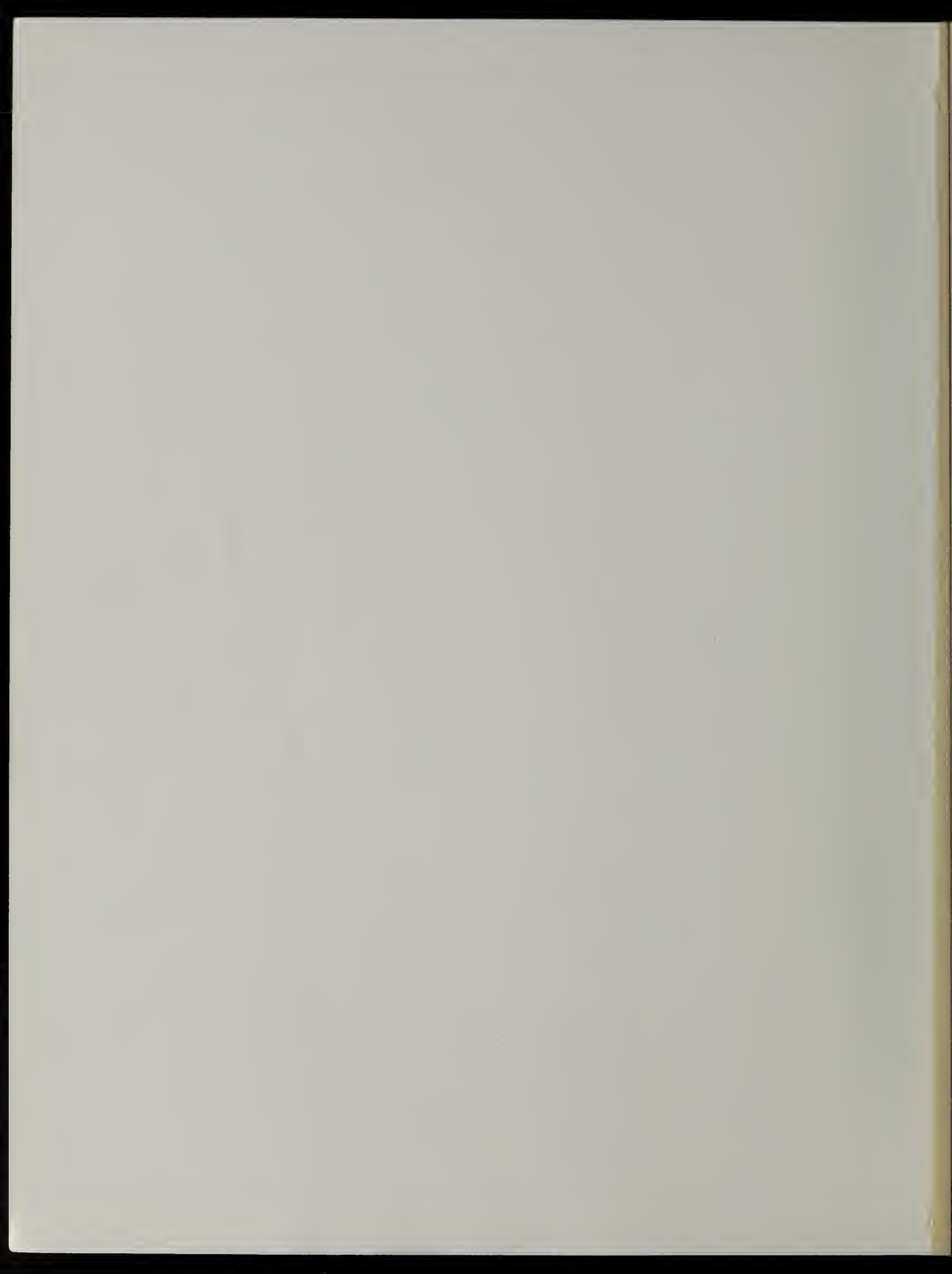


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University of Massachusetts Lowell

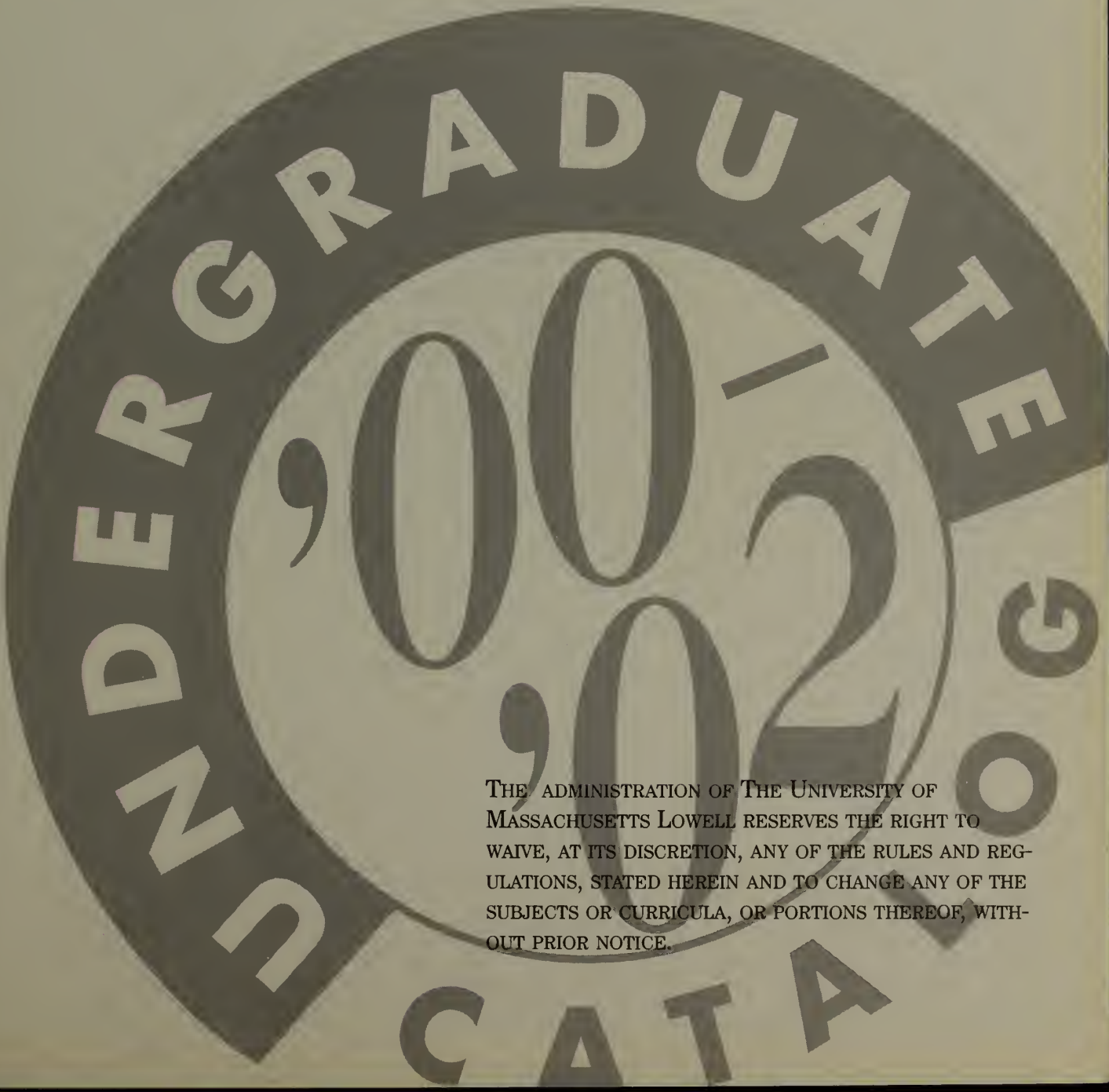




2000 - 2002

Undergraduate Catalog

One University Avenue
Lowell, Massachusetts
01854



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Undergraduate Catalog '00 - '02

UNIVERSITY OF MASSACHUSETTS LOWELL

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On July 11, 1991, in a ceremony on the front steps of Cumnock Hall, Governor William Weld signed into law a new University of Massachusetts. The University of Lowell became the University of Massachusetts Lowell. The University of Massachusetts, with campuses at Lowell, Worcester, Amherst, Dartmouth, and Boston, is governed by the Board of Trustees through the Office of the President, which is based in Boston.

Leadership of the

Lowell campus is vested in the Office of the Chancellor. The University of Lowell was established by Chapter 1175, Acts of 1973, General Law of the Commonwealth of Massachusetts, through a merger of Lowell State College and Lowell Technological Institute. Chapter 1175 directs the University to "provide, without discrimination, educational programs, research, extension, and continuing education services and in the liberal arts, in engineering and the sciences, and in the professions." It also authorizes the University to offer "the adult education services of the university extension program" and it confers "general authority to award any earned doctoral degrees" with the approval of Massachusetts Board of Higher Education.

University Profile



University Profile

Lowell State College and Lowell Technological Institute were established in the last decade of the 19th century as single-purpose institutions charged with providing instruction in those theories and practical arts most suitable to the teaching profession and the textile industry. Lowell State College was chartered by the General Court of the Commonwealth on January 6, 1894, as a teacher-training institution and was assigned the responsibility for providing "the most thorough knowledge of the branches of learning and right mental training." In 1932 the institution was made a four-year college and was granted the right to confer baccalaureate degrees. In 1960, the college became a multi-purpose institution by initiating non-teaching programs in the liberal arts. During the next decade and a half, the college continuously extended its mission and curriculum offerings at both the graduate and undergraduate levels and was authorized to offer degree programs in education, health professions, the liberal arts and sciences, and music.

From the time of its origin in 1895 as a proprietary textile school, Lowell Technological Institute has provided educational programs of an applied and practical nature. "Science and art will be taught," the original prospectus pointed out, "with a view to industrial and commercial applications" and for "the purpose of improving any special trade or of introducing new branches of industry." The control of the school was transferred to the state in 1918, and in 1928 it was granted collegiate status. In 1953, it became a multi-purpose technological institute. Prior to its merger with Lowell State College, the Institute phased out its textile curricula; it extended its curricular offerings in engineering, technology, science, business administration and industrial management; and it received authorization to offer degrees through the doctorate.

The merging of Lowell State College and Lowell Technological Institute brought together two multi-purpose institutions of differing character and orientation and made possible the creation of a comprehensive university whose strengths and

resources are manifestly greater than those possessed by the previous institutions.

The University occupies 43 buildings on three campuses (north, south, and west) and presently has a faculty in excess of 400 and a student enrollment of nearly 13,000. The curricula of the University encompass the customary disciplines of the liberal arts and sciences as well as a wide range of professions.

Mission of the University

The University of Massachusetts Lowell, located in the northeast section of Massachusetts, is publicly supported by the Commonwealth of Massachusetts and in one of five campuses of the UMass system. As an institution of higher education having legislative mandates in areas of research, teaching, and public service, the University seeks to discover, integrate, and transmit knowledge for the benefit of the Commonwealth and the good of society. UMass Lowell has the additional, specialized mission of regional industrial development through the research and education in partnership with industry. The University offers degree programs at all degree levels through the doctorate. Although undergraduate program emphasis is upon professional areas in business, engineering, fine arts, health, and science, the University strongly believes in the value of a liberal arts education both for its own sake and as a major component of professional preparation. Graduate program emphasis is in areas where there is a strong regional need or where the University possesses superior resources. The University also provides maximum opportunity for life-long learning through a wide variety of credit and non-credit continuing education courses.

The University is committed to the promotion of scholarly research and creative, artistic achievement. It seeks to create new knowledge in the belief that an atmosphere of original inquiry supports both the instructional and public service goal of the University. It acknowledges its special obligation to provide quality teaching in all academic programs and continu-

ally seeks more effective methods of imparting knowledge and understanding.

Recognizing its role as a public institution, the University is committed to active involvement in community service through instruction, research, consulting, cultural events, and continuing education. Finally, the University recognizes its responsibility for implementing the principles of equal opportunity and affirmative action and is committed to ensuring that all students and employees, particularly those in protected designations, are guaranteed the benefits of a just and equitable system.

Accreditation and Professional Memberships

The University of Massachusetts Lowell is an accredited member of the New England Association of Schools and Colleges (NEASC). In order to provide reliable assurance of the quality of the educational preparation of its students, the University of Massachusetts Lowell desires applications from individuals who have graduated from schools which have been accredited by NEASC or other regional accrediting associations and accordingly supports the efforts of secondary school officials and governing bodies to have their schools achieve regional accreditation status.

Professional programs, as designated below, also have been accredited by appropriate national associations. Accreditation indicates that the University is recognized and approved by regional and national associations concerned with the quality of higher education and it assures that study undertaken here has transfer value to other accredited institutions of higher education.

Professional Accreditation

Accreditation Board for Engineering and Technology

(Baccalaureate degree programs in civil, chemical, electrical, mechanical, nuclear, and plastics engineering; electronic, mechanical, and civil engineering technology programs; and Master's degree programs in Work Environment)

American Assembly of Collegiate Schools of Business (Baccalaureate and Masters in Business Administration and Masters of Management Science in Manufacturing degree programs)

American Physical Therapy Association (Master's degree program in physical therapy)

Computing Science Accreditation Board (Baccalaureate degree program in computer science)

National Association of Schools of Art and Design

(Baccalaureate degree program in art, fine arts, and graphic design)

National Accrediting Agency for Clinical Laboratory Sciences

(Baccalaureate degree program in health and clinical sciences: medical technology option)

National Association of Schools of Music (Baccalaureate and Master's degree programs in music)

National Council for the Accreditation of Teacher Education

(Baccalaureate program in music education; graduate programs in education)

National League for Nursing

(Baccalaureate and Master's degree programs in nursing)

Professional Memberships

The University is a member of the following associations of higher education:

American Assembly of Collegiate Schools of Business

American Association of Colleges for Teacher Education

American Association of Colleges of Nursing

American Council on Education

American Society of Allied Health Professions

Association for Gerontology in Higher Education

Association for State Colleges and Universities

Association of University Programs in Health Administration

College Entrance Examination Board

Council of Colleges of Arts and Sciences

Massachusetts Association of Colleges of Nursing

National Association of Summer Sessions

National Association of State Directors of Teacher Education and Certification

National League for Nursing

National University Continuing Education Association

New England Board of Higher Education

North East Consortium of Colleges and Universities in Massachusetts

University Organization and Governance

All University agencies, units, and departments report directly or indirectly to the Chancellor. Reporting directly to the Chancellor are the vice chancellors and the special assistant to the Chancellor for affirmative action.

The University is organized into three service areas, each of which is under the supervision of a vice chancellor.

The following officers report to the Provost and Vice Chancellor for Academic Affairs: the Associate Provost, the Assistant Vice Chancellor for Enrollment Management, the Dean of the Graduate School, the deans of the several colleges, the Registrar and the Director of Libraries. The following operations are under the jurisdiction of the Provost: the University's interdisciplinary research centers, the Research Foundation, and the academic computing services.

The Vice Chancellor for Administration and Finance exercises jurisdiction over the following offices: technical services, accounts payable, accounts receivable, the comptroller, duplicating services, financial aid, general accounting, mail services, human resources, the physical plant, purchasing, security, the stockroom, telecommunications and networking, and the treasurer.

The Vice Chancellor for University Relations and Development oversees the offices of: Alumni Relations, University Advancement, Communications and Marketing, and Economic Development.

Instructional units of the University include five colleges, a graduate school, and the division of corporate education and continuing studies.

College of Arts and Sciences

The Office of the Dean of the College of Arts and Sciences, Division of Sciences, is located in Olney Hall on North Campus, and the Office of the Dean of the College of Arts and Sciences, Division of Fine Arts, Humanities, and Social Sciences is in Durgin Hall on South Campus. The office of faculty and department chairpersons are located in the following buildings:

Biology Sciences	Olsen, North
Chemistry	Olney, North
Computer Science	Olsen, North
Criminal Justice	Mahoney, South
Earth Sciences	Olney, North
Economics	Falmouth, North
English	O'Leary, South Falmouth, North
History	Coburn, South
Languages	Coburn, South
Legal Studies	Falmouth, North
Mathematics	Olsen, North

Philosophy	Olney, North
Physics	Olney, North
Political Science	Coburn, South
Psychology	Mahoney, South
Sociology	Coburn, South

Facilities of the college include experimental laboratories for animal and human learning, a microcomputer laboratory, a criminalistics laboratory and language laboratory facilities. Practicum experiences for the various curricula are conducted in social and governmental agencies and in business firms of the Greater Lowell and Merrimack Valley areas.

Modern facilities and equipment in the Olsen, Olney, and Wannalancit buildings and in Mahoney Hall include teaching laboratories; modern computer equipment; undergraduate and graduate research facilities; office research modules; service areas such as animal quarters; rooms for instrumentation, preparation, temperature and humidity control; and X-ray, electron microscope (transmission and scanning), greenhouse and library facilities.

Graduate School of Education

The Graduate School of Education offers graduate programs only. The offices of the dean and the faculty of the Graduate School of Education, as well as all education classes, are located on the West Campus. The Graduate School of Education offers elementary and secondary teacher certification in conjunction with master of education degree programs. Certificate of advanced graduate study and doctor of education degree programs are also offered. Students who are interested in teaching or other careers in education should address their inquiries directly to the office of the dean. The School includes: the Center for Field Service and Studies, which develops collaborative programs with elementary and secondary schools, operates a two-way

television network and recruits undergraduates to serve as volunteers in K-12 schools; the Demonstration School, a partnership with the Lowell Public Schools, which fosters bilingual language development for children beginning at age three years; the Tsongas Industrial History Center, which offers hands-on learning of history, science and technology and is operated in collaboration with the Lowell National Historic Park at the Boot Mills; and the Economic Education Center which provides resource to teachers in order to promote an understanding of economics in the elementary and secondary schools.

James B. Francis College of Engineering

The College of Engineering is housed in the following facilities on the North Campus: Ball Hall, Engineering Building, Falmouth Hall, Kitson Hall, Pasteur Hall, and Southwick Hall. The offices of the Departments of Electrical, Mechanical and Energy, and Plastics Engineering are located in Ball Hall. The Department of Chemical Engineering is located in the Engineering Building. Civil Engineering is in Falmouth Hall. The offices of the dean are in Kitson Hall.

College of Health Professions

The College of Health Professions is located in Weed Hall (South Campus), which houses the offices of the dean and the chairs of the Department of Health and Clinical Sciences, the Department of Nursing, and the Department of Physical Therapy. Special classrooms, laboratory facilities and a student lounge are also located in Weed Hall.

Facilities in the college include a variety of fully equipped state-of-the-art laboratories, an audiovisual laboratory, a computer laboratory, an interactive video lab and anatomy and physiology laboratories. Simulated health and clinical sciences laboratories are available in the areas of chemistry hematology, microbiology, and immunohematology. The department of Nursing provides three simulated laboratories with the most modern nursing and life support equipment. Its audiovisual laboratory is equipped for self-paced instruction

in basic and advanced nursing skills. Laboratories of the Exercise Physiology major are supplied with state-of-the-art equipment. Computer laboratories, containing microcomputers and several terminals which are connected to the University's mainframe computers, are available for assisted instruction and simulation for each department in the college. The majority of clinical experiences for medical technology, health education, nursing, and exercise physiology programs are conducted in public schools, health agencies, and corporations and hospitals of the region.

College of Management

The College of Management is located in the North Campus quadrangle in Pasteur, Falmouth and Southwick Halls. The administrative offices of the College are located on the third floor of Pasteur Hall. The College's student microcomputers lab, equipped with the latest technology, is in Pasteur 205. Department offices are located in Pasteur 213 (Accounting), Southwick 301 (Management and Policy and Planning Department) and Falmouth 205 (Manufacturing/Management Information Systems Department).

Corporate Education and Continuing Studies

The Division of Corporate Education and Continuing Studies, with over 20,000 credit course enrollments annually in a variety of educational programs, offers degree programs at both the associate and baccalaureate levels, certificate programs, and credit courses for part-time, non-matriculating students. Undergraduate courses are offered not only in the Fall and Spring semesters, but during an intensive three week Winter Intersession as well as two six-week Summer terms (both day and evening). The Division also offers Summer Graduate courses and a Summer Writing Program.

In addition, the Division sponsors Community Education offerings which include courses for adults whose interests range from personal enrichment to professional advancement.

The Professional Institutes Program designed for people seeking recertification

or career updating features such specialized offerings as: PC User Institute, Multimedia User Institute, Entrepreneurship Institute, Health Care Institute, Teacher Recertification, and Executive Development seminars.

The Office of Special Programs manages over 150 professional development seminars and conferences, frequently showcasing University of Massachusetts Lowell faculty and departments.

At present, Continuing Studies courses are offered on the main campus in Lowell, the Mogan Center, the Woods Hole Oceanographic Institute, and various on-site business locations. Brochures listing all credit course offerings are available approximately six weeks prior to each semester's opening date. The administrative offices of the Division of Continuing Education are located in Southwick 307.

Graduate School

The Graduate School offers extensive professional and research programs at both master's and doctoral levels. Master's programs are offered in 53 areas. Combined B.A./M.A. and B.S./M.S. degree programs are also available to outstanding undergraduate students in biological sciences, chemical and energy engineering, civil engineering, criminal justice, electrical engineering, industrial technology/work environment, mathematics, mechanical engineering, plastics engineering, psychology, and radiological sciences. The College of Education offers Master's programs in educational administration, curriculum and instruction with options in Bilingual and ESL education, and reading and language (M.Ed.) Doctoral programs are offered in science and mathematics education, leadership in schooling, and language arts and literacy (Ed.D.), electrical, mechanical, and plastics engineering (Eng.D.); in computer science and work environment (Sc.D.); and in chemistry and physics (Ph.D.). The Certificate of Advanced Graduate Study is offered in reading and language, curriculum and instruction, and educational administration, planning and policy. Many courses are offered in the late afternoon and evening, and most programs can be com-

pleted on a part-time basis. Offices of the Graduate School are located in Falmouth 311.

Combined Bachelor's/Master's Degree

The UMass Lowell Graduate School offers a unique opportunity to combine a bachelor's degree with a graduate program and obtain a master's degree after one additional year of study. Upon graduation from the university, students with the combined bachelor's/master's degree often find they have a distinct advantage in the competitive job market. Highlights of the program include: 1) students with a 3.0 or greater grade point average are eligible to apply; 2) an application must be submitted in the junior year; 3) no Graduate Record Exam (GRE) is required; 4) up to 12 credits of graduate work above the university minimum of 120 credit requirement can be used for both the bachelor's and master's degree; 5) after students earn the bachelor's degree, they are eligible for teaching or research assistantships to help pay for the cost of graduate education.

Departments participating in the Bachelor's/Master's program: Biological Sciences, Chemical & Energy Engineering, Civil Engineering, Clinical Laboratory Sciences, Computer Science, Criminal Justice, Electrical Engineering, Psychology, Mathematics, Mechanical Engineering, Plastics Engineering, Radiological Sciences, Work Environment. The Bachelor's/Master's in Education* is offered in these areas: Biological Sciences, Chemistry, English, Earth Science, History, Mathematics, Physics. [*The Graduate School of Education has additional standardized test requirements.]

To request an application:

☎ : 1-800-656-GRAD, or
978-934-2380, or
978-934-2381

fax: 978-934-3022

e-mail: Graduate_School@uml.edu

Web: <http://www.uml.edu/grad>, or stop by the Graduate School Office at Falmouth 311. The complete Graduate School catalog with detailed degree program descriptions is located on the web site.

Academic Services

Academic services include the Academic Computer Center, the Centers for Learning and Academic Support Services (CLASS), the Honors Program, the College Consortium for International Studies, the University libraries, and the Research Foundation.

Academic Computer Center

The University of Massachusetts Lowell provides a large, sophisticated computer network in which 2500 terminals, microcomputers and workstations are linked to more than 150 multi-user computer systems via a campus-wide communications network based on both Ethernet and FDDI, supporting all the major protocols. An integrated voice/data switch allows substantial expansion of this data capacity to all segments of the university population. It is the policy of the University to issue computer accounts to all University students. Public access clusters of terminals, microcomputers and workstations are distributed around the campus.

We maintain large separate central facilities for general-purpose academic and administrative operations. These systems consist of clusters of DEC VAX 6420s, 8700s and 8800's running the VMS operating system and support over 600 concurrent terminal sessions. The systems provide access to a comprehensive selection of modern compilers, editors, data base systems, libraries (SPSS, IMSL, NAG, etc.), software development tools and commercial grade application packages (SDRC IDEAS packages, DEC software library, SPICE, ANSYS, FEAP, MOLD-FLOW, etc.). The university library system is fully computerized and accessible via the campus networks.

These central systems also support university-wide electronic mail, electronic conferencing and videotext capabilities; access to high speed, high quality laser output is also available via this cluster. The University has recently undertaken the replacement of its word processing systems with microcomputers that are linked to the academic cluster for document exchange and file storage.

Dedicated computing facilities are also distributed throughout the colleges and

academic departments. The heaviest concentrations of dedicated terminals, workstations and super minicomputer systems are installed in the Engineering and Computer Science areas. Engineering resources include: file and compute services provided by a VAX cluster (6310 and 6510 systems), DS 5100 ULTRIX server, several micro Vaxs and a Data General AViiON supporting over 150 graphics terminals and workstations. Special purpose systems include: an HP 1000 for real-time structural analysis, VAX 8530 and Vaxstations for VLSI and semiconductor design, ALLIANT FX/80 and FX 8 for computational fluid dynamics and several Concurrent systems for real time applications.

Support for the Computer Science Department's research and academic programs includes: DEC VAXs (8550, 8350s, microVaxs), Data General MV 7800 and AViiON RISC systems, Sequent Balance 21000, Intel Hypercube, DEC RISC systems and a number of special purpose smaller systems. All major systems and some 90 workstations are interconnected by several LANs and the University broadband network.

Each of the other Colleges have their own dedicated facilities to supplement the central computer center. We have experienced explosive growth in the demand for and access to microcomputers (count exceeds 1500). A network of over 300 workstations (DEC, HP/Apollo, SUN, DG and IBM) support design, software development and analysis needs. Very high performance graphics mini super-computers from Stardent, Apollo and PIXAR are available as distributed resources for large compute and graphics intensive tasks.

Centers for Learning and Academic Support Services

The purpose of this department is to provide support services to students to optimize their academic performance and to foster the development of innovative instructional strategies. Services are provided through the Centers for Learning and Academic Support Services (CLASS) and are comprised of three program components: Educational Computing, Tutoring and Educational Planning, and the Freshman Year Program.

Educational Computing

The Educational Computing program hosts four computer labs that provide easy access to users and feature a wide variety of MS-DOS, VAX and Macintosh computers and a multimedia workstation. Drop-in users consult with technical assistants to learn about the latest innovations in hardware and software applications. Students can obtain assistance in developing papers and projects for courses. The faculty work with staff to develop applications of computer technology for instructional purposes. The labs maintain an extensive library of software that includes programming and statistical packages, graphics and desktop publishing, word processing and a host of tutorial software.

The Tutoring Program

The Tutoring Program strives to promote academic success by having highly qualified undergraduates tutor their peers. Tutors work with students collaboratively in both small group and individual sessions to enhance student performance in over thirty subjects. Students who feel that they are not adequately prepared for their courses or who are having difficulty understanding particular concepts may drop-in to work with a tutor in that subject. Tutors work with students to deepen their understanding of course material by reviewing problems and concepts and by allowing the student to proceed at his/her own pace. Some students check in with tutors to clarify a small question, while others work with the tutors on an on-going basis. Tutoring is available in many required freshman and sophomore subjects such as College Writing, mathematics and sciences, and management. Students hired as tutors are recommended by faculty, complete an orientation program and participate in monthly staff training. Tutoring schedules are available each semester.

Educational Planning Office

The goal of the Educational Planning Office is to enable students to assess their own abilities and talents while exploring the full range of educational opportunities at University of Massachusetts Lowell. A drop-in center has been established where students can access information regarding career goals and related academic pro-

grams and requirements. An advising handbook, which features up-to-date information on major and minor requirements and University policies and procedures, is available for students and faculty. Financial planning information and study skills workshops are also available through this office.

The Freshman Year Program

The goal of the Freshman Year Program is to enhance the freshman experience by facilitating the successful transition from high school to college. To accomplish this, the program works closely with the faculty and staff to provide on-going orientation regarding innovative learning strategies. There are two components to this program: Strategies for Success and Project Restart.

Strategies for Success

A series of innovative orientation programs and publications targeted to freshman survival, the purpose is to provide freshmen with timely and meaningful information about survival skills, learning strategies, and University policies and procedures.

The Honors Program

The Honors Program has been established to provide enriched academic opportunities to meet the educational needs of exceptionally talented students and to foster the pursuit of scholarly excellence in undergraduate higher education. By fostering interactions among outstanding, motivated students and outstanding, dedicated faculty, the Honors Program is directed toward the recruitment, development, guidance, retention and professional growth of gifted students in activities designed to enhance their critical, cognitive and creative potential. The Program is conducted through a 20-member Honors Council, composed of administration, faculty and staff representatives. The University requires that freshman honors students meet two out of four conditions:

- 1) They must have a combined SAT score of 1200 or better (or ACT score of 26 or better);
- 2) They must have graduated in the top 15 percent of their high school class;

3) they must provide at least two written recommendations from principals, high school counselors or senior teachers; and

4) they meet special circumstances.

Transfer into the Honors Program is also permitted up to the first semester of the junior year. To graduate with an Honors Diploma as well as their academic Degree, students must have obtained at least 24 credits in Honors courses and maintained a cumulative GPA of 3.25 or better.

Regular students who are not members of the Honors Program may also participate in honors courses. Such honors courses are provided in three forms: (i) Designated Honors Courses;

(ii) Honors Sections of regular courses, and (iii) Contract Honors for individual students desiring to take a given course at an elevated level. A thriving Freshman Honor Society, affiliated with Alpha Lambda Delta, inducts students who have obtained a grade-point average of 3.5 or better in their first year of study. The Program emphasizes a personalized approach to small classes and aims to bring out the very best in students who strive for the highest accomplishments.

The College Consortium for International Studies

The College Consortium for International studies, a partnership of colleges and universities two and four-year, large and small, public and private, domestic and foreign encompasses the broad spectrum of international higher education.

Through its members, CCIS sponsors a variety of programs, notably study abroad programs and professional development seminars for faculty and administrators, which are designed to enhance international/intercultural perspectives within the academic community. Recognizing the value of such experiences in fostering global understanding and peaceful cooperation among nations in an increasingly interdependent and rapidly changing world, CCIS is committed to developing international dimensions as an integral part of collegiate education. CCIS works to build collaborative arrangements among institutions who share this commitment, and to facilitate linkages between member institutions and international partners. In all of its programs and activities, CCIS strives for a high level of academic excellence.

Study Abroad Programs include thirty-five programs (semester, academic year, and short-term) in twenty-one countries worldwide: Bulgaria, Canada, China, Colombia, Costa Rica, Cyprus, Ecuador, England, France, Germany, Greece, Ireland, Israel, Italy, Jamaica, Japan, Mexico, Portugal, Russia Spain, and Switzerland; and

twenty summer programs in fourteen countries worldwide: Bulgaria, Canada, Cyprus, Costa Rica, Ecuador, England, France, Germany, Greece, Israel, Italy, Portugal, Russia, and Spain.

The Consortium also provides Internships/Work-Study Programs in Bulgaria, Cyprus, Ecuador, England, France, Germany, Israel, Italy, Jamaica, and Russia.

University Libraries

The University library system consists of facilities at four locations. The O'Leary Library, located on the South campus, concentrates on resources in education, music, health, the humanities and social sciences; Lydon Library, situated on North Campus, has resources focused on sciences, technology and management. The Instructional Resource Center on West Campus supports such Graduate School of Education programs as mathematics and science, curriculum design and initial certification. The Center for Lowell History at the Mogan Center in downtown Lowell contains a variety of manuscripts, books, and photographic and oral history, materials on Lowell, the textile industry, immigrants, the Boston and Maine Railroads, and other special collections.

Present library holdings include over 400,000 volumes; 625,000 micro form items; 2,900 videos; 8,600 music scores; 6,000 sound recordings; 3,500 videotapes; 360,000 government documents; and 3,700 current periodical subscriptions. The fully automated library catalog of holdings can be accessed at any of the libraries; at terminals throughout the University via the campus network; and remotely via dial-up ports. The library provides direct access to the on-line catalogs of major research libraries throughout the United States, electronic interlibrary loan processing

through OCLC and remote database searching through Dialog and STN. The Library offers computerized end-user search and full text retrieval from over 85 CD-ROM and internet accessible databases.

The library offers services in search strategy development, ready reference, tailored bibliographies of library holdings, general library tours and specialized library instruction for individuals and classes. Media services include individual, class, and large group viewing facilities for video and multi-media projects, and production of visual, audio and multi-media materials.

Career Services

The Career Services staff assists students to develop the skills and understanding needed to make informed choices during their career life. Career development workshop topics include: resume creation, cover letter writing, interview skills and job search strategies. Individual career counseling appointments are available to assist students with specialized concerns.

A comprehensive library of electronic and printed resources is provided for job market research and skills development. Students are able to use several office computers with internet access and one with Career Search, a database product that expedites employer identification. Links to recruiting employers and job search engines are easily found on the Career Services website: <http://ocs.uml.edu>. Additional material includes company information binders, videos and literature for over 2000 companies.

The Recruiting Employers Program is designed to assist students learn about employers and the job market. Binders of current job listings are categorized by functional areas of interest and by industries. Specialized job fairs and career events are organized and hosted on-campus. On-campus recruiting interviews are carried out by over 200 employers throughout the academic year. Off-campus recruiting interviews are generated through the electronic mailing and faxing of student and alumni resumes.

The University Career Advisory Network (UCAN @ Lowell) is a database of professionals and alumni who have volunteered to act as information resources. These individuals have agreed to talk with students and alumni about their career interests and networking sources.

Career Services & Career Related Experiences

The Career Services office provides a centralized operation for students to explore cooperative education and internship opportunities. All postings are organized and maintained in a system of binders and directories. Cooperative Education opportunities for Engineering and Computer Science can also be found on the Career Services website.

The College of Engineering, in cooperation with Career Services, offers an optional, academic credit bearing Cooperative Education program. In order to participate, students must: complete their freshman year and at least one full academic semester at UML; maintain good academic standing; and obtain the approval of their department's faculty co-op advisor.

Additional academic disciplines offer the possibility of experiential education through internships, field experience, clinical rotations or cooperative education. Some of these many areas include: Computer Science, Accounting, Marketing, Political Science, Health Professions, Education and Music. Please review the policies and requirements of your area of study.

Office of Student Services Cumnock Hall X2100

Ellen C. Duggan
Dean of Students

Thomas C. Taylor
Assistant Dean of Students

This office provides leadership in the development of services, programs, and activities that enrich the college experience and contribute to an environment that encourages personal growth. In addition, the Deans serve as liaisons to other administrative offices, the college administration, and the faculty. The office serves as a clearinghouse for information which affects students, and it is a good "first stop" for any student looking for answers. More specific services include the following:

- ◆ Academic advising advocacy
- ◆ Commencement ushers
- ◆ Emergency student loans (\$50 for 30 days)
- ◆ Faculty notification of student absences (1 week or more)
- ◆ ID card operations
- ◆ Inter-Campus transportation (Shuttle busses)
- ◆ Judicial and Conduct Code Procedures
- ◆ New student orientation programs
- ◆ Religious Life programming
- ◆ Specialized issue and Program committees

There are eight divisions within student Services providing a wide variety of services to students. These offices are noted below and students are encouraged to contact them should they need additional information and/or have questions:

The Office of Residence Life- Cumnock Hall

Larry Siegel, Director 934-2107

The Office of Student Activities, Commuter Services & Student Centers-

McGauvran Student Center 224
Mary Connelly, Director 934-5001

Counseling Center- McGauvran Student Center

Dr. Noel Cartwright, Director 934-4331

The Office of Student Health Services- McGauvran Student Center

Nancy Quattrocchi, Director 934-4991

The Career Services Office- Southwick Hall

Pat Yates, Director 934-2352

The Office of Disability Services- Cumnock Hall

Elizabeth Donaghey, Director 934-2114

The Office of Community Service- McGauvran Student Center 335

Dr. Mark Levine, Director 934-3219

ALANA Student Center- McGauvran Student Center 335

Dr. Lanett Scott, Director 934-4336

Research Foundation

For additional information, contact Louis J. Petrovic, Director, External Funding, Technology Transfer, and Partnering, University of Massachusetts Lowell Research Foundation, 600 Suffolk Street, Second Floor South, Lowell, MA 01854; Telephone: 978-453-6586; E-mail: Petrovic@woods.uml.edu

Athletics

UMass Lowell men's and women's intercollegiate athletic teams are highly regarded throughout New England and the nation.

Five UMass Lowell teams have captured NCAA team championships, while seven student-athletes have won NCAA individual titles. Since 1975, UMass Lowell student-athletes have earned 140 All-American citations.

UMass Lowell offers 20 intercollegiate varsity sports. The men's ice hockey team competes at the Division I level, and all other sports compete at the NCAA Division II level.

Varsity Programs:**Fall**

Cross Country (M&W), Field Hockey (W), Football (M), Soccer (M&W), Tennis (W), Volleyball (W)

Winter

Basketball (M&W), Ice Hockey (M), Indoor Track (M&W), Swimming (M)

Spring

Baseball (M), Crew (M&W), Outdoor Track (M&W), Softball (W), Tennis (M)

Recreational Sports

For students who seek athletic opportunities outside of our varsity program, we offer over 30 intramural sports, ranging from the traditional to the innovative; sports clubs that provide instruction and competition against other institutions; and high quality, low cost fitness instruction.

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Admissions Policies

The following pages describe in detail University requirements and processes concerning the admission of high school graduates, non-traditional students, and transfer students; the admission of international students and candidates for second degrees;

the admission of non-matriculating students; and the readmission of previously enrolled University students. These pages also provide basic information concerning

degree programs, applicant inquiries, application deadlines, advanced placement, health certification requirements, and the Commonwealth Transfer Compact.

Admission General Policies

Admission to all baccalaureate day programs is made through the Office of Undergraduate Admissions and according to established undergraduate policies. Admission to programs of continuing education or to summer school, which is made through the Division of Continuing Studies & Corporate Education, does not constitute admission to baccalaureate day programs and implies no commitment, per se, for subsequent application of continuing education or summer school courses to baccalaureate day programs. It is the policy of the University of Massachusetts Lowell that students seeking admission to either regular or continuing education programs will be evaluated on their merits and (as prescribed in applicable federal and state laws) without respect to their race, color, creed, national origin, age, gender, handicap, sexual orientation, veteran status or marital status. The University makes a special attempt to attract students from various racial backgrounds and disadvantaged environments.

The admission policies of the University of Massachusetts Lowell, which are in keeping with its mission and the guidelines of the Massachusetts Board of Higher Education, specify procedures for admitting three types of applicants for undergraduate degrees:

1) high school seniors and individuals who have graduated from high schools within the past three years; 2) non-traditional students; and 3) transfer students. Accordingly, these policies not only protect the intellectual integrity and strength of the University by requiring standards of preparation and objective evidence of the student's potential for success but also provide access for a diverse student population, including traditional and non-traditional students and students with special needs and talents. Individuals who are admitted by the Office of Undergraduate Admissions must be accepted under one of the following categories:

1. as undeclared students (entering as freshmen or transfer students with less than 60 semester credits) who wish to establish initial matriculation for a degree which is offered by one of the colleges of the University of Massachusetts Lowell;
2. as declared students (entering as freshmen or transfer students) who wish to establish initial matriculation for a Lowell degree and who have a commitment to an academic major or professional program which is offered by one of the colleges of the University;
3. as declared students with advanced standing who wish to pursue a second baccalaureate degree at Lowell after having completed an initial baccalaureate degree at the University or other accredited institution; or as non-matriculating students admitted on a semester-by-semester basis.

To be admitted for undergraduate study, applicants must present records of academic performance which indicate a reasonable probability of success in their chosen programs or colleges. For regular freshman admission to an undergraduate college or degree program, probability of success is measured by an individual's high school record, class standing, and standardized test results and/or by his or her academic record at the University of Massachusetts Lowell for prescribed provisional courses of study. For regular transfer admission to an undergraduate college or degree program, probability of success is measured by an individual's previous academic record at some other accredited institution of higher education. Within the space available in particular programs, admissions are offered first to those whose performance record indicates the highest probability of success in the chosen college and/or program. Specific academic standards requirements are described below under headings for admission categories.

The University welcomes correspondence from prospective students who may need

assistance in adapting their high school programs to satisfy specific program requirements. Such correspondence should be addressed to the Office of Undergraduate Admissions, University of Massachusetts Lowell, 883 Broadway Street Room 110, Lowell, Massachusetts 01854-5104. Requests for application forms should be directed to the same office.

Applicant Decisions Concerning Program Selection

Entering freshmen who prefer to test their abilities and interests or who wish to explore several areas of study before identifying themselves with one of the baccalaureate day programs can request admission as undeclared students. Students transferring 60 or more credits may not request status as undeclared students and must enter the University with a commitment to an academic major or professional program. Undeclared students are advised that openings in a desired professional program may be inadequate to accommodate all qualified undeclared student applicants at the time when program declarations must be made (upon completion of 45 credits). When resources of a college or program render it necessary to establish admission quotas, differential admission criteria above and beyond specified admission requirements will be applied in the selection of applicants as matriculating students.

The University of Massachusetts Lowell operates on a rolling admission plan. To confirm an offer of University admission, an applicant who has been approved for admission to any program must make a required tuition deposit within fifteen days of the date on his or her official acceptance letter. A refund of the tuition deposit will be made to individuals who notify the Office of Undergraduate Admissions by May 15th that they wish to cancel their University admission. A refund of the tuition deposit will not be made after May 15th.

Baccalaureate degree programs are offered by the Colleges of Arts and Sciences, Engineering, Health Professions,

and Management. Continuing education degree programs at both the associate and baccalaureate degree levels are offered in the evening. Applicants who wish to apply for continuing education programs should address their inquiries to Continuing Studies & Corporate Education, One University Avenue, Lowell, MA 01854. Teacher-preparation programs are offered at the graduate level.

Programs

Bachelor of Arts

American Studies
Economics
English
History
Modern Languages
Philosophy
Communications & Critical Thinking Option

Political Science
Psychology
Sociology
Undeclared Liberal Arts

Bachelor of Engineering

Chemical Engineering
Civil & Environmental Engineering
Electrical & Computer Engineering
Mechanical Engineering
Plastics Engineering
Undeclared Engineering

Bachelor of Fine Arts

Fine Arts
Graphic Design

Bachelor of Liberal Arts

Liberal Arts

Bachelor of Music

Music Teaching Preparation
Performance
with emphasis in
Sound Recording Technology
Music Business

Bachelor of Science

Math & Sciences
Biological Sciences
Biotechnology Option
Chemistry

Computer Science
Criminal Justice
Environmental Science
Atmospheric Science Option
Environmental Studies Option
Geoscience Option
Mathematics
Physics
Radiological Health Physics Option
Undeclared Science

Health Professions

Clinical Laboratory Science
Clinical Science Option
Medical Technology Option
Exercise Physiology
Community Health Education
Nursing
Undeclared Health

Management

Business Administration
with concentrations in:
Accounting
Finance
Management
Management Information Systems
Marketing
Industrial Management
Undeclared Business

Change of Baccalaureate Program Declaration After Application

Individuals who are admitted to specific programs or to a college with an undeclared student status and who wish to change their designations of program or college admission may do so by notifying the Office of Undergraduate Admissions. Changes will be approved only if space in the desired program or college permits and the applicant has satisfied all admission requirements for the newly designated college or program. Changes in program designation can be made after registration by filing requests for change of major and/or intercollegiate transfer within the University.

Admission Policies for Traditional Students

Graduating High School Seniors and High School Graduates

Graduating high school seniors and high school graduates who wish to be admitted to the University as matriculating students must comply with the following:

1. file an official application form with the University of Massachusetts Lowell prior to April 1;
2. request high school principals or guidance directors to forward to the Office of Undergraduate Admissions transcripts of secondary school grades including grade reports for at least the first quarter of the senior year;
3. arrange to take the College Entrance Examination Board Scholastic Aptitude Tests.

Detailed information concerning the College Entrance Examination Board tests and the dates throughout the year on which they are administered may be secured from the Office of Undergraduate Admissions of the University of Massachusetts Lowell, high school principals or guidance directors, or the Educational Testing Service, Princeton, New Jersey 08540. Special information is provided in the following sections concerning required aptitude examinations for applicants to music programs and for satisfaction of department language requirements through the Foreign Language Achievement Tests of the College Entrance Examination Board. Following receipt of application forms, transcripts of high school records, and Scholastic Aptitude Test scores, the Office of Undergraduate Admissions may arrange appointments for personal interviews of applicants. The responsibility for having all credentials forwarded to the University of Massachusetts Lowell rests solely with the applicant.

Admission Requirements for Graduating High School Seniors and High School Graduates

The general expectation is that applicants will present course work which has been taken within college preparatory curricula.

However, the Office of Undergraduate Admissions will evaluate the academic units of vocational technical school (Chapter 74) graduates to determine their relevance for University curricula. The ultimate judgment concerning such equivalency rests solely with the University of Massachusetts Lowell. The following pages specify prescribed high school unit requirements and other qualitative requirements for the admission of freshmen students. Applicants must satisfactorily complete prescribed units prior to enrollment. Table I specifies the high school unit distribution which is required for general University admission.

Prescribed High School Unit Requirements Table I

General University Admission

Subject	Units Required
. English	4 courses
. Mathematics	3 courses (Algebra I & II and Geometry or Trigonometry, or comparable coursework)
. Sciences	3 courses (including 2 course with laboratory work)
. Social Sciences	2 courses (including 1 course in U.S. History)
. Foreign Languages	2 courses (in a single language)
. Electives	2 courses (from the above subjects or from the Arts and Humanities or Computer Sciences)
Total Prescribed Units	16

Qualitative Requirements for the Admission of Freshman Students

Graduating high school seniors (including applicants graduated from secondary schools within the last three years) who seek freshman admission as matriculating students must comply with the following:

An applicant must present a high school GPA of 3.0 or above as calculated at the time of application and weighted with consideration of honors courses and advanced placement courses.

If a student's GPA falls below the minimum required, the following sliding scale will apply. This scale should be used only

when a student's GPA falls below the 3.0 minimum.

GPA	Year 2000 Combined SAT Scores Must Equal or Exceed	Year 2001 Combined SAT Scores Must Equal or Exceed
2.51-2.99	940	950
2.41-2.50	980	990
2.31-2.40	1020	1030
2.21-2.30	1060	1070
2.11-2.20	1100	1110
2.01-2.10	1140	1150

Note: SAT test scores are re-centered scores.

Students who meet the minimum GPA requirement must submit SAT or ACT tests scores if they are applying to UMass Lowell within three years of high school graduation. These test scores may be used in determining eligibility for specific majors.

*SAT Requirements

College of Arts and Sciences Division of Fine Arts, Humanities, and Social Sciences

Verbal 480 Math 480 Comb 960

Division of Math and Sciences

Verbal 500 Math 500 Comb 1000

College of Engineering

Verbal 500 Math 500 Comb 1000

College of Health Professions

Verbal 500 Math 500 Comb 1000

(Undeclared Health)

Verbal 480 Math 480 Comb 960

College of Management

Verbal 500 Math 500 Comb 1000

(Undeclared Business)

Verbal 480 Math 480 Comb 960

Music Aptitude and Proficiency Examinations

College of Arts & Sciences (Music Programs)

Students who wish to apply for music programs are required to demonstrate vocal or instrumental ability in a performance audition with a member of the faculty of the College of Arts & Sciences. The stu-

dent is also required to achieve satisfactory scores on both a written test of music fundamentals and a brief examination in aural comprehension. Performance auditions and theory testing are scheduled throughout the academic year. Applicants will be invited to take these special music tests at the University when all credentials have been approved by the Office of Undergraduate Admissions.

Application Procedures for International Students

Applicants who are residents of international countries are required to supply the Office of Undergraduate Admissions with SAT scores, secondary school and/or college records, as well as all other application materials, submitted in English. All international students must file the financial resource form, Certification of Finances, which evidences sufficient financial resources for their years of study at the University.

Applicants must have considerable facility in speaking and writing English, and prospective students whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). A score of 500 or above is required by the University. Students are responsible for making arrangements for taking this test and should address inquiries to: TOEFL, Educational Testing Service, Princeton, New Jersey 08540, U.S.A. The completed application form should be returned to the Testing Service at Princeton well in advance of the application deadline. The test fee, which should be remitted with the application, entitles the student to have his test score sent to three different institutions. Registration for the Test of English as a Foreign Language does not constitute application for admission to the University of Massachusetts Lowell. The bulletin of information, obtainable without charge, contains a description of the test as well as rules regarding application, fees, reports and the conduct of the test; lists of examination centers and examination dates; and an application blank. On the application for the test, the student should specify that his score be sent to the Office of Undergraduate Admissions, University

of Massachusetts Lowell, 883 Broadway Room 110, Lowell, Massachusetts 01854-5104. In addition to the TOEFL, an admitted student may be required to report to the Office of Undergraduate Admissions to make arrangements for taking an English placement test for foreign students prior to registration. Results of this test may determine the courses for which the student will be permitted to register in his or her program of study.

Application Procedures and Requirements for Non-Graduates of High Schools

Individuals who have not graduated from high school may be admitted to the University upon satisfactory completion of the General Educational Development tests and receipt of a certificate of high school equivalency. Such students are required to take the Scholastic Aptitude Tests of the College Entrance Examination Board prior to their application and to present scores which are acceptable to the University. Admissions procedures for students possessing certificates of high school equivalency are the same as those which are prescribed for graduating seniors and high school graduates.

Admission Policies for Non-Traditional Students

Students applying for admission more than three years after high school graduation, or who have completed the GED and whose high school class graduated three or more years prior to applying to college, must show their ability to succeed in college based upon their high school and/or college transcripts.

Students who drop out of high school, earn a G.E.D., and apply to college within three years of when their high school class graduated are subject to the same admissions standards as students applying within three years of graduation from high school.

Patricia A. Goler Fellows Program

The Dr. Patricia A. Goler Fellows Program is named for the distinguished educator, historian and civil rights leader who served the University of Massachusetts

Lowell for over 30 years, and the Commonwealth of Massachusetts for even longer. Each year, this program provides a structured plan for a limited number of freshmen who are first in their families to attend college and/or whose family earnings are less than 150% of the statewide poverty level. Eligible students must have earned a GPA of 2.5, and a minimum combined SAT of 850.

English as a Second Language (ESL) Applicants

English as a Second Language (ESL) students must have minimum score of 500 on the Test of English as a Foreign Language. In cases where a student's language ability is questionable, UML will require an additional measurement of language proficiency administered by UML's ESL Coordinator.

Fresh Start Program

UMass Lowell permits students who have been absent from the University for two or more years to be readmitted under the Fresh Start Program. Under the terms of this program, a returning student will be treated as if he or she were a transfer student. Courses completed during earlier periods of enrollment with grades of "C" or better will be accepted toward graduation but will not be included in the cumulative average. Courses completed during earlier periods of enrollment with grades of below "C" will not be counted toward graduation nor included in the cumulative average.

Transfer Students

Application Procedures and Requirements

In general, the University of Massachusetts Lowell will accept on an hour-for-hour basis semester credits with grades of C- (1.750 on a 4.000 scale) or better as shown on official transcripts of record which are received directly from other accredited collegiate institutions and which are applied to an initial baccalaureate degree.* Quarter credits are recognized on a prorated basis of three quarter credits to two semester credits. (Students who are interested in transferring credits for an additional baccalaureate degree should consult the appropriate section below concerning such admission.)

Preference for admission to the University is based upon the record of each individual transfer applicant at the end of the semester preceding admission. All credits to be transferred must be identified at the time of application for transfer. The University reserves the right to deny credit for course work taken by the student prior to admission if it is identified and presented after transfer.

*No credit will be recognized for the grade of P unless the catalog of the transferring institution specifically states that P is equivalent to a final course grade of C- (1.750 on a 4.000 scale).

Students who transfer from four-year institutions must complete a minimum of 30 semester credits at the University of Massachusetts Lowell to be eligible for a Lowell baccalaureate degree. The University will not reduce the minimum residency requirement of 60 semester credits for students who present 60 or more semester credits from a two-year college. The records of applicants 1) who have completed associate degree programs or who have established matriculation at other accredited institutions of higher education and 2) who are eligible to return to such institutions for the semester in which they seek admission to the University are routinely processed by the Office of Undergraduate Admissions for regular transfer admission.

Required Credentials for Transfer Applicants

It is the responsibility of students seeking transfer to the University for arranging with the institution in which their previous work was completed to forward to the Office of Undergraduate Admissions official transcripts of their completed courses and notations of all courses in progress.

Additionally, final transcripts of all completed courses must be forwarded to the Office of Undergraduate Admissions following the completion of previously designated courses in progress. Transfer students whose records are incomplete on the first day of semester classes may be prohibited from attending courses and may be required to withdraw from the University.

An applicant who has attended one or more institutions must request each registrar to mail directly to the Office of Undergraduate Admissions a transcript of his or her record even though credits were not earned or credits are not presented for transfer.

Transfer students must meet one of the following criteria:

1. 12 or more transferable college credits and a minimum of 2.5 college GPA;
2. Up to 23 transferable college credits, a minimum 2.0 college GPA, and a high school transcript that meets the admissions standards for freshmen applicants; or
3. 24 or more transferable credits and a minimum 2.0 college GPA.

Transfer students who have fewer than 12 transferable college credits must meet the admissions standards for freshmen applicants.

Evaluation of Transfer Credentials

A preliminary evaluation of course credits to be transferred to the University is made by the Office of Undergraduate Admissions at the time of application. Students seeking transfer should be aware that this evaluation by the Office of Undergraduate Admissions is preliminary in nature and that acceptance of transfer credit and assignment of a year of graduation or other status is subject to final review by the student's major department when the student is formally accepted for matriculation by one of the colleges of the University. Credit which is acceptable according to general University standards is not necessarily acceptable for specific programs. This is especially true when program transfer quotas have been imposed. The Office of Undergraduate Admissions will advise applicants when their admission to the University does not guarantee acceptance into their preferred professional programs. The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Massachusetts Lowell is

determined by policies of each of the colleges.

University Restrictions Concerning Transfer Credit Recognition

Courses completed at non-public institutions which are not accredited by the major regional accrediting associations will not be credited to degree programs of the University. Nor will credit be granted for courses which are unacceptable to the transfer institution for its own associate or baccalaureate programs or which are completed within post-secondary school diploma programs. Non-credit CEU courses, adult-enrichment or refresher courses, and secondary school correspondence and home study courses also are not recognized for transfer credit. The University reserves the right to refuse recognition for courses which were taken more than ten years prior to the date when a student applies for transfer when, in the opinion of department chairpersons and program directors, the knowledge attained in such courses is deemed to be out of date and/or in need of verification. Competencies which a student has achieved through such courses, or by any other means, may be recognized for credit if verified by CLEP or department examinations.

College and Program Restrictions Concerning Transfer Credit

Many colleges and programs impose additional restrictions on the acceptability of transfer credit. The College of Health Professions and the College of Management have special regulations governing the acceptance of transfer credits for professional courses. Transfer applicants to these colleges should consult the dean of the college or the appropriate department chairperson concerning transfer credit for these courses. The College of Arts and Sciences does not accept in transfer professional courses from any program or curriculum whatsoever with the exception of courses credited to the degree program in the Administration of Criminal Justice. Students transferring to the College of Arts and Sciences may transfer course credits in science and mathematics if these courses are equivalent to those specified by the curricula of the college. Prerequisites for courses in the major field within the College of Arts

and Sciences or courses which are prerequisites to admission to the college may not be credited to the minimum degree requirements in mathematics or the sciences.

As a general rule, courses of a professional nature from any curriculum are not accepted in transfer when a student seeks admission to a different curriculum or program at the University of Massachusetts Lowell. Transfer applicants should consult the appropriate dean or departments for current regulations. Additionally, transfer applicants who enter the University in one program, or as undeclared students, may find that certain credits will be deleted from the record when they seek internal transfer to another college or program.

Initial Review of Transfer Students for Compliance with University Retention Standards

For the purpose of determining academic standing, student records are reviewed each semester. Transfer students are initially evaluated for retention purposes at the end of the semester in which they have attempted their first 18 credits at the University.

The Commonwealth Transfer Compact

The University of Massachusetts Lowell has affirmed its intention to maintain flexibility in the transfer of qualified students from community colleges of the Commonwealth of Massachusetts. For the implementation of this objective, the University of Massachusetts Lowell has subscribed to the Commonwealth Transfer Compact and applies to students who apply for admission under this compact the same policies which are applied to University of Massachusetts Lowell students who petition for intercollegiate transfer within the University.

All courses which have been accepted by the University from signatory community colleges of the Commonwealth Transfer Compact are listed on the student's transcript, and those courses which are not applicable to specific curriculum requirements are credited, whenever possible, as unrestricted elective courses. Since some curricula of the University do not provide for such unrestricted elective courses, or the number of transferred courses may

exceed the number of unrestricted elective courses which are permitted within the specifications for minimum degree requirements, transferred courses which are not applicable to the specific requirements of a curriculum are not counted in the determination of the number of course credits completed until the semester of graduation. This procedure prevents the early imposition of a grade point requirement for retention which is in excess of that specified for the number of credits completed and applicable to the student's particular curriculum.

The revised Commonwealth Transfer Compact (1990) provides a process to facilitate the transfer of collegiate credits and to ensure the appropriate recognition of academic progress earned by students at a community college who wish to continue their education at a public college or university.

For Students Transferring from Massachusetts Community Colleges to Public Colleges and Universities Offering the Baccalaureate Degree
Section I. Requirement for Transfer Compact Status

A student shall be eligible for Transfer Compact status if he or she has met the following requirements:

- a. completed an associate's degree with a minimum of 60 credit hours exclusive of developmental coursework;
- b. achieved a cumulative grade-point average of not less than 2.000 (in a 4.000 system) at the community college awarding the degree; and
- c. completed the following minimum general education core, exclusive of developmental coursework

English Composition/Writing	6 cr
Behavioral and Social Science	9 cr
Humanities and Fine Arts	9 cr
Natural or Physical Science	8 cr
Mathematics	3 cr

The sending institution is responsible for identifying the transcript of each student who is a candidate for transfer under this compact.

Section II. Credits to be Transferred
The 35 credits in general education speci-

fied in Section I will be applied toward the fulfillment of the receiving institution's general education requirements. A minimum of 25 additional credits will be accepted as transfer credits by the receiving institution. These credits may be transferred as 1) free electives, 2) toward the receiving institution's additional general education requirements, 3) toward the student's major, or 4) any combination, as the receiving institution deems appropriate.

Only college-level course credits consistent with the standards set forth in the Undergraduate Experience recommendations are included under this Compact. Credits awarded by the sending institution through CLEP, challenge examinations, and other life-experience evaluations for course credit may be included when the community college certifies that a student qualifies under this Compact.

Section III. Credits Beyond the Associate Degree

To complete the baccalaureate degree, a student who transfers under this compact may be required to take no more than 68 additional credits unless:

- a. the student changes his or her program upon entering the receiving institution; or
- b. the combination of additional general education requirements, if any, and the requirements of the student's major at the receiving institution total more than 68 credits.

Under these circumstances, transfer students will be subject to the same requirements as native students. (The term "native student" refers to students who began their undergraduate education at the baccalaureate institution.)

Section IV. Admission to Competitive Majors or Programs

If, because of space or fiscal limitations, the receiving institution does not admit all qualified applicants to a given major or program, the receiving institution will use the same criteria for applicants who are transfer students under this Compact as it does for its native students.

Joint Admissions Program with Massachusetts Community Colleges

The University has joined with the fifteen Massachusetts community colleges to guarantee admission to students upon completion of designated transfer associate's degree programs with a minimum 2.5 cumulative grade point average. Students who elect this option upon enrollment at the community college will receive coordinated advising assistance, periodic communications from University departments, early course registration, financial aid, and campus housing consideration.

Tuition Advantage Program (TAP)

Joint Admissions students who earn a 3.0 GPA or higher are also eligible for the Tuition Advantage Program. This entitles the student to a 1/3 reduction in tuition (Massachusetts) as long as the student maintains a 3.0 GPA.

Other Associate Degrees and Certificates

Massachusetts public community colleges may award other associate degrees and certificates with a primary objective other than student transfer to a four-year institution. Course credits from such programs which are presented for transfer will be evaluated by the four-year institution according to their applicability to general education requirements, to unrestricted elective courses, and to requirements in the student's major field.

Applicants for Additional Baccalaureate Degree

A student who has earned a baccalaureate degree at the University of Massachusetts Lowell or at another accredited baccalaureate institution may be admitted to the University to pursue an additional baccalaureate degree subject to the following requirements:

1. the nomenclature of the additional degree to be pursued must be distinctly different from the previously conferred degree;*
2. the major field of the previous degree must be clearly distinct from that of the additional degree;

3. the work for the additional degree must consist of not less than two semesters (or the equivalent) of full-time study;

4. the final 30 credits presented for the additional degree must be in addition to and independent of any previously-awarded baccalaureate; and

5. a minimum of 15 credits must be taken at the University in the major field which is presented for the additional degree.

*e.g., Bachelor of Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Engineering, Bachelor of Science in Business Administration, etc.

Candidates for the additional baccalaureate degree must earn a minimum of 30 credits and must comply with any special college regulation concerning completion at the University of major field and professional program requirements (including collateral and prerequisite course requirements for the major/professional program). Second degree candidates may be eligible for major field honors but are not eligible for University honors unless they have completed 60 credits at the University for the additional baccalaureate degree.

Application for admission to the University as a candidate for an additional baccalaureate degree is made through the Office of Undergraduate Admissions. Prior to admission to the University as candidates for additional baccalaureate degrees, applicants must be approved by the college in which they plan to matriculate and the department in which they intend to major. Retention standards for candidates for additional baccalaureate degrees are based upon the grade-point averages for achieving satisfactory standing which are specified for the several levels of course credits completed. Grade-point averages are computed solely on the basis of qualitatively graded courses which have been completed at the University for the additional baccalaureate degree. The number of course credits completed include those which have been applied from previous baccalaureate programs (cf. "Academic Policies: Determination of Academic Standing").

Application Procedures for Non-Matriculating Students

Admission as a non-matriculating student is granted only under provisions which govern the non-degree programs cited below. Applicants for admission as non-matriculating students are required to file admission applications and to submit such credentials as are specified for their proposed non-degree programs. A non-matriculated student may be readmitted subject to the following conditions: 1) the student has satisfactorily completed his or her previously attempted courses, 2) the original condition under which the student initiated non-matriculating studies permits continued enrollment, and 3) commitments of the University to matriculating students permit enrollment of non-matriculating students.

Dual Enrollment Program for High School Seniors

The Massachusetts Dual Enrollment Program was established by the Education Reform Act of 1993. The program provides qualified high school juniors and seniors the opportunity to take courses at public colleges and universities and thus earn both high school and college credit. Participants in this program are required to have a 3.0 GPA or better and be recommended by their high school principal or guidance counselor. Dual Enrollment students must file an application with the Office of Undergraduate Admissions and submit high school transcripts, along with a parental signature allowing them to take classes on campus. The University reserves the right to decline admittance to students on the basis of academic ability.

Programs for Students Matriculated at Other Colleges and Universities (Visiting Students)

Students who are matriculates for degrees at associate or baccalaureate institutions may be admitted to the University to pursue specifically authorized courses. Such students are admitted to the University on a semester-by-semester basis and must secure prior approval for University courses from appropriate authorities at institutions where their degrees will be granted.

Permission to enroll in courses of the University will not be granted to students without a letter from an appropriate officer of the institution in which they are matriculating which certifies that they are candidates for a degree and are in good academic standing. Courses of a professional nature may not be elected by non-matriculating students of the University unless specifically authorized by the appropriate college dean.

Day Programs for Students Matriculating for Continuing Studies & Corporate Education

Students who have established matriculation for University of Massachusetts Lowell continuing education degrees at either the associate or baccalaureate levels may be permitted to pursue specifically authorized day courses. Such students must secure the written approval of their program coordinators for all projected courses prior to filing an application with the Office of Undergraduate Admissions. Full notation of approved courses (including those failed) is made upon the permanent record of Continuing Studies & Corporate Education students.

Programs for University Employees

University employees who are high school graduates or who possess certificates of high school equivalency may apply for admission as non-matriculating students. Admission is extended to employees as non-matriculating students on a semester-by-semester basis and solely for courses designated at the time of application. Employees who wish to matriculate for a baccalaureate degree should apply for admission. Participation in this program is subject to employee obligations and special policies of the Board of Trustees.

Non-Matriculating Programs for Students Holding Baccalaureate Degrees

An individual who holds a baccalaureate degree and who wishes to pursue a limited non-degree program (up to a maximum of 15 credits) may be admitted full- or part-time to the University as a non-matriculating student. Such admission requires the approval of each of the departments in which courses are contemplated.

University of Massachusetts Lowell graduates should indicate their dates of graduation on their application forms. Other applicants must request the registrars of the institutions in which their degrees were conferred to mail transcripts of their baccalaureate records directly to the Office of Undergraduate Admissions and are warned that permission to enroll in courses will be denied if transcripts have not been received prior to course registration. A student who holds a baccalaureate degree and who wishes to pursue a second baccalaureate should investigate the appropriateness of both degree and non-degree programs of the Graduate School before applying for such status.

Readmission Procedures for Previously Enrolled Students of the University of Massachusetts Lowell (Non-Graduate)

The University does not grant leaves of absence to students who wish to interrupt their baccalaureate studies. Accordingly, students who have withdrawn from the University and who seek readmission must file an application for readmission with the Office of Undergraduate Admissions. When resources of a college or program render it necessary to establish limitations upon enrollments, the Office of Undergraduate Admissions will establish a waiting list of applicants for transfer and reinstatement. Differential admissions criteria above and beyond minimum program requirements may be applied to these individuals to ensure the admission and readmission of the most qualified applicants for the limited openings.

Upper division students in the College of Health Professions who have withdrawn must make individual arrangements with appropriate chairpersons to reserve their spaces in courses for the semester of the anticipated return to the University. Unless such special arrangements have been made, reinstatement by the Office of Undergraduate Admissions cannot ensure full resumption of a student's course of study.

In the event that readmission applicants wish to change their programs and/or to seek readmission to the University in a college other than that which they previously attended, their reinstatement must be approved by the chairperson of the program to which they seek admission and the appropriate college dean. If program enrollments permit, approval for such readmission will be granted to students who satisfy all program admission requirements. Individuals who seek readmission to the University in a college other than that which they previously attended will be subject to re-evaluation procedures which are specified for enrolled students who seek an intercollegiate transfer (cf., policies governing intercollegiate transfers which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer"). Individuals who apply for intercollegiate transfers must submit their applications no later than November 1st for spring semester reinstatement and April 1st for fall semester reinstatement.

Unqualified Reinstatement

Individuals who were students in satisfactory academic standing prior to their withdrawal and who have not been absent from the University for more than one semester are automatically reinstated to the programs in which they were previously enrolled and are subject to curriculum requirements which are in effect for the classes to which they previously belonged. Application for readmission must be filed with the Office of Undergraduate Admissions.

Qualified Reinstatement

Students who have been absent from the University for two or more continuous semesters are subject to the rules and regulations of the University which are in effect at the time of their readmission rather than at the time of their original admission. If program enrollments permit, individuals who were students in satisfactory academic standing prior to their withdrawal ordinarily are reinstated to the programs in which they were previously enrolled. However, during an individual's absence some programs may have established higher entrance and retention

requirements and he or she may be denied reinstatement for failure to satisfy these requirements.

Individuals are not automatically reinstated to the programs in which they were previously enrolled when they have been absent from the University for periods exceeding ten years. Course work which has been completed prior to ten years of the date of readmission is generally recognized only through those examination procedures described in the policy statements for course equivalency. Such course work may also be evaluated on an individual basis by the academic standards committee of the college in which an applicant desires to re-establish his or her matriculation. Students who wish to have such course work evaluated by the committee must present their cases in writing to the committee.

Individuals who have been suspended from the University for unsatisfactory academic standing may apply for readmission only within policies which govern probationary readmission.

Probationary Readmission

A student who has been suspended from the University is entitled to apply for readmission as a full-time probationary student but may not initiate his or her probationary studies before an absence from the University of one semester. Application for such readmission to all programs, except continuing education curricula, is made through the Office of Undergraduate Admissions and must be received by April 1st for a readmission decision during the spring semester and by November 1st for a readmission decision during the fall semester.

Petitions which have been received by the filing deadline of November 1st will be reviewed by the appropriate academic standards committee during the fall semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the spring semester. Similarly, petitions which have been received by the filing deadline of April 1st will be reviewed by the appropriate academic standards committee during

the spring semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the fall semester. Probationary studies may be authorized during the fall and spring semesters in day classes only.

Upon the receipt of an application, the Office of Undergraduate Admissions will forward all readmission papers to the academic standards committee of the college to which the student applies. Except as prohibited by the academic policies of professional colleges, suspended students may petition for readmission to the University with probationary status as follows: 1) all suspended students may petition for readmission to the college in which they were previously enrolled and may request re-enrollment in the former major or readmission with a change of major; 2) freshmen students and sophomore students who have not attempted more than 45 credits or have not completed more than three full-time semesters also may petition for simultaneous intercollegiate transfer and probationary admission to a new program. Students who have attempted 45 credits or three full-time semesters are not eligible for intercollegiate transfer at the time of probationary readmission.

Students who are readmitted to colleges from which they were previously suspended must achieve satisfactory academic standing for all course hours completed by the end of their probationary semester. Students who are permitted to make an intercollegiate transfer will be permitted to transfer all applicable courses which have been completed with grades of C or better and will be required to attain a probation average of 2.000 in order to achieve satisfactory academic standing.

After securing recommendations from appropriate departments and studying the previous academic record of the student, the academic standards committee will lay down the requirements which the student must satisfy as a condition for his or her probation (specific courses to be taken, conference schedules with faculty advisors, and any other special or general academic condition which may be construed as necessary for the student's successful

completion of his or her probationary studies). In determining such requirements for probation, the academic standards committees shall prescribe a sufficient number of courses for a student who has been readmitted to the college from which he or she has been suspended, which shall make the achievement of satisfactory academic standing reasonably possible during a full-time semester of probation. For complete information concerning probationary requirements, cf. "Undergraduate Academic Policies: Academic Standing."

Advanced Placement Policies for Baccalaureate Applicants

Students entering the University as freshmen or as transfer students may elect to challenge courses through established procedures cited below. University departments reserve the right to refuse the granting of credit for those examinations which are presented by a student for his or her major(s). Equivalency credit is granted for laboratory components of science courses only through examinations of University departments. Accordingly, science credits which are granted through the College Level Examination Program and Advanced Placement Examinations of the College Entrance Examination Board do not waive any specified laboratory requirement, including those of the University core curriculum.

College Level Examination

Program: General Examinations

Entering freshmen may be granted University credit for general examinations if they have achieved minimum designated scores. General examination credit is granted at the time of admission only. Students who change major fields subsequent to receiving credit for general examinations are advised that previously granted credits are automatically nullified if their new majors are in an area in which general examination credit has been granted.

CLEP	Maximum Exam Score	Required Credits
English Composition*	550	3

Mathematics+	6
500	
Natural Sciences+	6
500	
Social Sciences#	6
500	
Humanities@	6
500	

* A score of 550 satisfies the requirements for College Writing I.

+ Credit may be granted only to students who matriculate for degrees in the College of Arts and Sciences. Natural science credit granted does not satisfy the specific laboratory course requirement of the revised University Core Requirements.

Credit may be granted only to students who matriculate for degrees in the College of Arts and Sciences, and the College of Management.

@ Credit will not be granted for a general examination in an area which is cognate with a student's major. For example, credit for the general humanities examination will not be granted to students who major in art, English, languages, music, philosophy, or other humanities areas.

College Level Examination

Program: Subject Examinations

Entering freshmen and transfer students may be granted university credit for subject examinations of the College Level Examination Program when they have achieved scores which are on or above the C grade level. A complete listing of subject examinations of CLEP for which the University grants credits may be found elsewhere in this publication under the heading "Academic Policies: Course Equivalency Examinations.

Advanced Placement Examinations of the College Entrance Examination Board

Entering freshmen who have demonstrated college level proficiency through advanced placement examinations of the College Entrance Examination Board may be granted University credit for scores of 5, 4, and 3. Credit will not be given for scores of 2 or 1.

The following is a listing of advanced placement examinations for which the University grants course credit:

AP Examination

Course Equivalent

Credit

American History

43.111 U.S. History to 1877 and

43.112 U.S. History Since 1877 6 cr

Biology

83.101 Life Science I,

83.102 Life Science II,

83.103 Life Science I Lab &

83.104 Life Science II Lab 8 cr

or

81.111 Principles of Biology I,

81.112 Principles of Biology II,

81.113 Principles of Biology I Lab &

81.114 Principles of Biology II Lab 8 cr

Chemistry

84.121 Chemistry I,

84.122 Chemistry II,

84.123 Chemistry I Lab &

84.124 Chemistry II Lab 8 cr

Classics-Virgil

56.303 Selected Latin Authors 3 cr

Classics-Latin Lyric

56.303 Selected Latin Authors 3 cr

Economics

49.201, 202 Economics I & II 6 cr

English

42.101 *College Writing I 3 cr

*Score of 3

A score of 4 can take departmental exam for additional 3 credits of College Writing II. A score of 5 equals 6 credits for 42.101 and 42.102.

European History

43.105 Western Civilization and

43.106 The Modern World 6 cr

French Language

50.211 Intermediate French I and

50.212 Intermediate French II 6 cr

French Literature

50.261 Literature of Ideas and

50.262 Selected Writings 6 cr

German Literature

51.211 Intermediate German I and

51.212 Intermediate German II 6 cr

Government Politics

46.101 Intro in American Politics 3 cr

Physics C - Mechanics

95.141 Physics I 3 cr

Physics C - Electricity & Magnetism

95.245 Physics III 3 cr

Mathematics: Calculus AB

92.131 Calculus I 4 cr

Mathematics: Calculus BC

92.131, 132 Calculus I and II 8 cr

Music

74.161 Music of Western Civ 3 cr

71.110 Music Theory 3 cr

(non-music majors only)

Physics B

95.103 General Physics I and

95.104 General Physics II 6 cr

Psychology

47.101 General Psychology 3 cr

Spanish Language

54.211 & 212 Intro to Spanish I & II 3 cr

Spanish Literature

54.301 Intro to Spanish Literature 3 cr

54.302 Intro to Latin American

Literature 3 cr

Foreign Language Achievement Tests of the College Entrance Examination Board

University credit is granted upon the recommendation of the Department of Languages to entering freshmen who have demonstrated satisfactory language competency through the Language Achievement Tests of the College Entrance Examination Board. University credit on the intermediate course level will be given to students achieving scores

of 550 or better. Such credit will satisfy any language proficiency requirement specified for students by their major departments.

Course Credit Limits Through Advanced Placement With Credit

The maximum number of credits which may be granted to any student through advanced placement procedures, including departmental equivalency examinations, is 42 semester credits. Under no circumstances will duplicate examination credit be granted to students who present formal course work for transfer. Nor will examination credit be granted to transferring students for the purposes of reducing either the major field residency requirement of 15 credits or the general residency requirement of 30 credits in University day courses.

Services for Learning and Physically Disabled Students

The University and its programs and activities are becoming increasingly more accessible to academically qualified students who are physically and learning disabled. Although some architectural barriers still remain, disabled persons can traverse the campus with a minimum of difficulty. University libraries, the student unions, several residence halls, and more recently-constructed classroom buildings are accessible to students in wheel chairs. Early registration, preferential scheduling, housing assistance, readers, note-takers, interpreters, alternative testing procedures, reduced course load, and special parking arrangements are some of the accommodations available to disabled students. For further information contact the Office of Student Services, Cumnock Hall, North Campus.

Since admission to the University is based entirely on the academic qualifications of the applicant, admission procedures remain the same for all applicants, regardless of disability.

Equal Opportunity and Title IX

Federal and state laws require that no student be discriminated against or harassed on the basis of age, national origin, race, sexual orientation, religion, sex or handi-

capped, marital, or veterans status. The Affirmative Action office, which has the overall responsibility for the implementation of Equal Opportunity/Affirmative Action, is located in Cumnock Hall (North Campus). This office deals not only with discrimination and harassment complaints but also with the monitoring of actual practice and written policies and procedures, e.g., student activities, course offerings, teacher and student attitudes. Any student who believes that he or she has been discriminated against or harassed or who believes that the University in any of its aspects is operating in a manner which adversely affects female, handicapped, minority students, or veterans should contact the Affirmative Action office immediately.

Health Certification Requirements for Admission

All students, as part of the condition of admission, are required to have on file a complete up-to-date medical history and physical exam form, evidence of a recent Mantoux +6 test, and proof of completed up-to-date immunizations as mandated by law.

The college immunization law requires all full time students born after 1956 and all full or part time students in the health sciences, regardless of age, to provide a medical certificate of immunization against measles, mumps, rubella, tetanus and diphtheria. The month and year must be given.

The measles vaccine must have been administered after 1968 and after the age of one, and there must be two doses at least one month apart.

The rubella vaccine must have been administered after one year of age. History of disease must be verified with a positive titer.

Proof of a mumps vaccination or physician diagnosed disease must be given.

The Tetanus-Diphtheria injection must be within the past ten years.



Financial Information

The information provided covers all matters relating to University expenses (including state, federal, and University policies governing fees, residency and non-residency tuition rates, payment schedules, tuition waivers, the New England Regional

Program, and financial requirements for international students) and to financial aid programs (including V.A. benefits and scholarship, loan, and work-study programs).

Financial Information

The following is intended to provide information related to the cost of attending UMass Lowell (including state, federal, and University policies governing fees, residency and non-residency tuition rates, payment schedules, tuition waivers, the New England Regional Program, and financial requirements for international students) and our student financial aid programs.

University Charges

The University charges noted below and in the following sections concerning food services and student housing are in effect for the 1999-2000 academic year. These charges are subject to change without prior notice, by the Massachusetts Board of Higher Education or the Board of Trustees of the University of Massachusetts. All policy statements, tuition and fee charges, and other information detailed below reflect information current at the time of the publication of this catalogue.

University Expenses

University charges include tuition, mandatory fees, applicable room and meal plan costs, and insurance(s). Please note that all charges are subject to change without notice.

Undergraduate Tuition:

Full-time (MA resident)
\$1,454.00 per yr

Full-time (non-resident)
\$7,871.00 per yr

Part-time (MA resident)*
\$60.58 per cr hr

Part-time (non-resident)*
\$327.96 per cr hr

*At the present time, tuition per credit hour, (cr hr) is applicable only for the following students: a) students whose petitions for part-time enrollment have been approved by their college dean and by the Office of Academic Affairs;

b) graduating seniors with fewer than 12

credit hours to complete their degree requirements (an academic petition is required);

c) students enrolled in the Encore Program or in the co-op program; and d) non-matriculated students enrolled in fewer than 12 credit hours.

Undergraduate University Fees

Application Fee (MA res) \$20.00

Application Fee (non-res) \$35.00

International Student Fee-annual \$76.00

Parking Fines:

1st offense \$5.00

2nd offense \$10.00

3rd subsequent offenses \$15.00

Parking Fines-Handicapped Spaces:

1st offense \$25.00

2nd subsequent offenses \$50.00

Returned Check Fee-per check \$30.00

Student Union Fee-annual \$50.00

Transcript Fee-per transcript \$1.00

Express Transcript Fee-per transcript \$5.00

In-State Univ. Operating Fee \$2,725.00

Out-of-State Univ. Operating Fee \$2,945.00

Late payment fee-per semester \$50.00

Room and Meal Plan Charges

Residence Hall

Double & triple occupancy rooms-annual
\$2,800.00

Single rooms and suites are available at slightly higher annual rates

Telephone Service Fee-annual
\$110.00

Meal Plans

7-meals per week-7 days

\$300-points-annual \$1,822.00

10-meals per week-7 days

\$250-points-annual \$1,926.00

10-meals per week-5 days only

No weekends, no "points" -

annual \$1,615.00

14-meals per week-7 days

\$126-points-annual \$1,926.00

19-meals per week-7 days

No points-annual \$1,926.00

Insurance Charges

Estimated cost for coverage
1999 - 2000

On-Campus Insurance-annual

All Students (mandatory) \$26.00

Health/Accident Insurance-annual

Single Student Rate \$525.80*

Liability Insurance-annual

College of Health Professions

Students on Clinical Affiliation \$16.00

* Insurance is mandated by Chapter 15A, Section 7B of the Massachusetts General Laws and effective September 1, 1989 for every full-time and part-time student enrolled in a public or independent institution of higher education in the Commonwealth. Students who are able on an annual basis to provide evidence, satisfactory to the University, of insurance comparable to that required by law may have this fee waived. Students must provide evidence of comparable coverage, each year they are matriculated, by the deadline established by the University.

Explanation of University Charges

Tuition Rates

Tuition rates are established on the basis of official state residency. Eligibility for in-state tuition is determined by regulations governing Massachusetts residency. Eligibility for New England Regional Student Program tuition rates is determined by regulations administered through the New England Board of Higher Education.

University Fees

Application Fee

State law requires institutions of public higher education to collect specified application fees. These fees are not refundable and are not applied to tuition.

International Student Fee

International students require special services including visa and immigration forms before and after they arrive on campus. This fee is used to defray the cost of the staff, equipment, and consultants related to those services.

Mass Student PIRG Fee

The Massachusetts Student Public Interest Research Group (Mass PIRG) is a state-wide, non-profit and non-partisan student-directed organization established to research and promote solutions to important environmental and social problems. It is a waivable fee benefiting Mass PIRG, voted and approved by student referendum. For the year(s) in which the PIRG fee is not passed by student vote, it will not appear on student invoices.

Student Union Fee

Funds derived from this fee are used to support the Student Union buildings.

Transcript Fees

A fee is charged to students who request an official or unofficial transcript of their permanent academic record. Official transcripts are not released if the student's account is not paid in full. The Express Transcript Fee applies to transcripts required with less than 24 hours notice.

University Operating Fee

The University Operating Fee is a curriculum/operational support fee. This supports all aspects of student life, including such services as the library, computer center, athletic facilities, laboratory fees and equipment fees.

Late Payment Fee

A late charge will be assessed any student currently enrolled, having an outstanding balance on his or her account that does not have a legitimate exemption for non-payment as of the due date noted on his or her student invoice. Exemptions include participation in the AMS payment plan, sufficient anticipated financial aid and/or loans, or direct billing of an approved third party.

Tuition Surcharge

Effective for the fall semester 1999-2000, the State Board of Higher Education mandated a surcharge on Massachusetts state university and college students who take more than the required number of credits

needed to graduate. The charge applies only to in-state and regional program undergraduates who begin their studies at UMass Lowell. The surcharge is equivalent to the out-of-state, per credit rate for each credit in excess of 118% of "required credits" for their baccalaureate degree. "Required credits" shall include credits for single and double majors, minors, and credits required for formal certification or licensing.

Where appropriate, the surcharge will be itemized on the student invoice. Students are advised that an appeals process is available to them; Surcharge Appeal Petitions will be considered by a review committee. Credits accumulated in the Division of Continuing Education courses will not be included in the count.

Annual Per Student Cost For UMass Lowell

UMass Lowell spends approximately \$12,424 annually providing classroom instruction for each student. There is a state subsidy of approximately \$8,069 and other sources of revenue that reduce the amount of tuition and mandatory fees charged Massachusetts resident students to \$4,255 or 34 percent of that actual cost.

Additional costs for books, supplies, transportation, and room and board when added to these tuition and fee charges result in an average cost of attendance estimated at \$10,744; which is roughly the figure from which a student's financial aid eligibility is determined.

Similar expenses for out-of-state students are considerably higher.

Note: Personal Income Tax Credits are available to qualified taxpayers. Those in effect at the time of this printing are as follows:

The HOPE Tax Credit

The Hope Tax Credit is a \$1,500 per year nonrefundable credit for qualified higher education expenses incurred for at least half-time enrollment during the first two years of a student's academic program leading to a recognized educational credential at an eligible institution. (per IRS 1998).

The Lifetime Learning Credit

The Lifetime Learning Credit is a \$1,000 per year nonrefundable credit for qualified higher education expenses incurred at any eligible institution. (per IRS 1998)

Further information regarding eligibility, income limitations, reporting requirements and due dates please contact either the IRS at 1(800)829-1040 or your personal tax preparer.

Residence Hall Charges**Residence Hall Rent and Reservation Deposit**

Residence hall charges are billed and payable in two installments prior to the beginning of each semester, along with charges for tuition and fees. Each student must submit a \$200.00 room guarantee deposit at the time the residence hall reservation and contract are submitted. The deposit reserves the room until the time of occupancy and is applied to the following spring semester residence hall charge of that student.

Telephone Service Fee

This fee is levied upon each student occupying a room with a telephone hook-up that is integrated into the University's telephone system.

On-Campus Insurance

Student on-campus insurance coverage for the academic year is obligatory for all matriculated and non-matriculated students. This insurance guarantees coverage of medical costs, up to \$10,000.00 (as of the date of this printing) for whatever balance is left after claims have been submitted to and paid for by the student's own insurance company, incurred due to mishaps on campus or while participating in a University sponsored event.

Student Health Insurance

As previously stated, student health insurance is mandated by Chapter 15A, Section 7B of the Massachusetts General Laws since September 1, 1989 for all full-time and part-time students enrolled in a public or independent institution of higher education in the Commonwealth of Massachusetts. A family plan is available

with options for coverage of spouses and/or spouses and dependent children. In addition, major medical coverage and a dental plan are available at an additional cost. For policies concerning compulsory reporting of illness or accident, please consult the insurance representative at the office of Health Services.

Payment, Refund, and Waiver Policies

Policies concerning University fees are determined by the University of Massachusetts Board of Trustees. Policies concerning room and meal plans are established by the Board of Trustees in conjunction with the UMass Building Authority and food vendor, respectively.

Tuition and tuition waiver policies are established either by the General Court, the Massachusetts Board of Higher Education, or the Board of Trustees of the University of Massachusetts, as applicable.

Payment of Bills

Students will be permitted to attend classes and to utilize University facilities only after they have cleared all their financial obligations to the University. Financial obligations in addition to tuition and fees include indebtedness for library fines, parking fines, rental payments, and repayment of emergency loans. All bills are payable on or before the due date indicated on student bills. Checks, money orders and major credit cards (Mastercard and VISA) are accepted. All payment of fees and tuition should be made payable directly to the University of Massachusetts Lowell. A student in debt to the University at the end of any semester or summer session is not permitted to register again at the University until his or her indebtedness has been discharged. Students are advised that the University utilizes the services of collection agencies authorized under the Commonwealth's Master Service Agreement and where deemed warranted may include litigation. Students are held personally liable for associated collection costs in the event that their account is sent to a collection agency. In addition, official student transcripts and diplomas will not be released until all indebtedness has been discharged.

Payment Plans

The University of Massachusetts Lowell also offers a low-cost monthly payment option presently administered by Academic Management Services, (AMS). This plan allows parents and students to budget their annual cost of tuition and fees over a nine or ten month period concurrent with the period of enrollment. Informational brochures are available at the Accounts Receivable Office, located in Dugan Hall 128, or by calling the AMS toll free number: (800) 531-4300.

International Student Deposit

For students requiring a Form I-20, Certificate of Eligibility, a \$4,000.00 prepayment of University tuition and fees must be received and credited to their student account before the form can be issued.

Bookstore Financial Aid Voucher Program

If anticipated financial aid exceeds a student's financial obligation to the University and the student has been otherwise financially cleared, the Accounts Receivable Office can authorize a Bookstore Voucher to be used at the UMass Lowell Bookstore for the purchase of text books and school supplies. At the end of the drop/add course enrollment period, bookstore purchases made through this program are charged directly to the student's account and will be repaid using that student's financial aid award(s). Should the actual financial aid award be reduced for any reason, the student becomes personally responsible for charges to the bookstore. If complete payment is not made, as with all charges, University services may be withheld, and the financial obligation will be sent to a collection agency. In such case, the student assumes responsibility for all associated collection costs.

Refund Policy

An undergraduate student who withdraws in writing from the University during the first half (50%) of the enrollment period will be granted a pro rata refund of tuition and designated fees. The enrollment period is defined as an academic term of 15 instructional weeks. The date of official academic withdrawal, as recorded by the Registrar's Office, is the primary basis of any claim for tuition refund. Refunds may also be authorized for documented rea-

sons and/or extenuating circumstances deemed acceptable to the Associate Provost or his designee. Non-attendance of classes does not constitute withdrawal from the University. The refund policy is applicable to all full-time and part-time undergraduates, including those enrolled through the Division of Continuing Education.

Undergraduates are eligible for refunds of tuition and designated fees in accordance with the following schedules and notations:

Withdrawal Date	Refund Entitlement
On or before 1st day of classes	100%
Up to the first 10% of semester	90%
Between 10% and 25% of semester	50%
Between 25% and 50% of semester	25%

Under no circumstances are application fees refundable. In addition, enrollment deposits required for accepted students, are refundable before May 15th for the fall term and December 15th for the spring term if the student withdraws in writing to the University. Under no circumstances are they refunded after these dates. Student Health and Student On-Campus Insurance are not refundable after the first day of classes.

In accordance with federal legislation, the University of Massachusetts Lowell has established a refund policy for students who are recipients of Federal Title IV financial aid moneys. Consistent with federal regulation, any remaining refund due to a student will first be applied to cover any unpaid institutional charges of that student before a distribution is made. Please contact the Accounts Receivable Office for further details. Please note that the refund policy is also subject to change without notice.

Refund on Room Reservation Deposit

The \$200 room reservation deposit reserves a space in the residence halls until occupancy and is applied to the spring semester room rental. This deposit is generally non-refundable except in the case of an academic dismissal or graduation from the University (see section below, Refund on Room Fees).

Refund on Room Fees

All cancellations of room contracts must be submitted, in writing, to the Office of Residence Life. In addition to forfeiting their room reservation deposit, students canceling their housing contract for reasons other than academic dismissal or graduation will be responsible for the room fees according to the following schedule:

Cancellation Received by Residence Life	Obligation for Room Fees
Through July 15	No further obligation
July 16 through 1st day of classes	50% of fall fee
2nd day of classes through the last business day in November	100% of fall fee
November	50% of spring fee
After last business day in November	100% of fall fee and 100% of spring fee

Reservation made after December 1st for spring semester

On or before 1st day of classes	50% of spring fee
On or after 2nd day of classes	100% of spring fee

Residents required to leave the residence halls and/or the University due to judicial sanctions will not be granted a refund of their room fees.

The Office of Residence Life has a Housing Contract Appeals Board to hear appeals from students who request exemption from the above refund schedule. This Board consists of the Director of Residence Life, a professional Resident Director, a member of the University Life staff and the president of the Residence Hall Association. Students may appeal their exemption from charges due to military obligations, change in personal situation, family finances, financial aid, illness, or other extenuating circumstances as may be deemed appropriate by the Appeals Board. All appeals must be documented in writing for review by the Appeals Board. The finding of this Board can be appealed to the Dean of Students whose decision is final.

Tuition Waivers for Senior Citizens

Tuition waivers are granted to senior citizens as specified by Massachusetts law.

Citizens of Massachusetts who are age 60 and over (senior citizens) are entitled to free tuition at the University on a space available basis. Positive identification and proof of age must be presented. Applicable fees, including mandatory student fees such as the University Operating Fee, and costs of instructional materials (books, etc.) are not covered by this waiver. In addition, tuition for short-term intensive workshops or seminars is not covered by this waiver. Senior citizens who are admitted as matriculating students must satisfy Tuition Waivers for Senior Citizens, (cont'd) established admission requirements for programs or must qualify for admission to the University through the Encore Program.

Veteran's Benefits

The Veterans Administration has approved the University of Massachusetts Lowell for undergraduate study. Veterans must present a certificate of eligibility available from the Veterans Administration, Kennedy Building, Government Center, Boston, Massachusetts. Upon receipt of this certificate, the University will notify the Veterans Administration to initiate monthly payments to the student. Veterans who are registered for twelve or more semester credits are paid for full-time training; for nine to eleven semester credits, three-quarter time training; and for six to eight semester credits, half-time training. A citizen of Massachusetts who is defined as a "Vietnam Veteran" and whose service is creditable to the Commonwealth may be issued a certificate of tuition exemption if he/she is enrolled in the University as a full-time student. Certificates must be renewed annually prior to the beginning of each academic year, are in effect only during such time as the student remains in good standing at the University, are limited to a period of study which may not exceed four years, and are issued during an eight-year period from the date of discharge or release from active service. In order to receive a certificate of tuition exemption, an eligible veteran must present his/her discharge papers at the Office of the Adjutant General, State House, Boston, Massachusetts, and must provide the University's Financial Aid Office with a

certificate of eligibility. A veteran who is entering the University for the first time is required to pay the application fee within the period designated on the application form for admission. The application fee is not refundable. Tuition exemptions do not cover fees of the University.

Rules Governing Massachusetts Residency for Tuition Purposes

These rules and regulations apply to the classification of students at UMass Lowell as Massachusetts or non-Massachusetts resident students for tuition and fee purposes. The Massachusetts Board of Higher Education, Board of Trustees, and Office of the General Counsel for the University of Massachusetts may revise or interpret this policy after the publication deadline for the 1999-2000 undergraduate catalogue. In that event, the revised policy will supersede the following.

Definitions

"Emancipated person," for the purposes of residency classification for tuition, shall mean a person who has attained the age of 18 years and is financially independent of his or her parents, or if under 18 years of age, a) a person whose parents have entirely surrendered the right to the care, custody, and earnings of such person and who no longer are under any legal obligation to support or maintain such person; or b) a person who is legally married; or c) a person who has no parent. If none of the aforesaid definitions apply, said person shall be deemed an "unemancipated person."

"Parent" shall mean:

- the person's father and mother, jointly;
- the person's mother, if the person's father is deceased, or the person's father, if the person's mother is deceased;
- the legal guardian, if a legal guardian has been appointed by a court having jurisdiction;
- the person who then stands in loco parentis to the person, if neither the father nor the mother is living and no legal guardian has been appointed; or
- the parent who has been awarded legal custody of the person, if the father and

mother are divorced, separated or unmarried, or the parent with whom the person lives, if legal custody has not been awarded.

With respect to any adopted student, the word "adoptive" should be inserted before the words "father" and "mother" wherever used.

"Reside," "residency" or "resident" shall mean "domicile," i.e., a person's true, fixed and permanent home or place of habitation, where he or she intends to remain permanently.

Classification

For the purpose of assessing tuition and fees, each student shall be classified as a "Massachusetts resident" or a "non-Massachusetts resident." A person shall be classified as a Massachusetts resident if he or she (or the parent of an unemancipated student) shall have resided in the Commonwealth of Massachusetts for purposes other than attending an educational institution for twelve months immediately preceding the student's entry or reentry as a student. Physical presence for this entire twelve-month period need not be required as long as the conduct of an individual taken in total, manifests an intention to make Massachusetts his or her permanent dwelling place. In addition, the opportunity to evaluate residency for tuition purposes will be made available to students for any semester subsequent to their entry or reentry. Under the Residency policy, the University is not required to apply in-state tuition rates retroactively to earlier terms of attendance for a student who is reclassified from a non-Massachusetts resident to a Massachusetts resident.

Determination of Residency

Proof of Residency

a. Each case will be decided on the basis of all facts submitted with qualitative rather than quantitative emphasis. A number of residency factors are considered for residency to determine the intention of the person to maintain permanent residence in Massachusetts. No single index is decisive. The burden of proof rests on the student seeking classification as a Massachusetts resident.

b. The following shall be primary indicators of residency:

1. The residency of custodial parents within Massachusetts (for unemancipated persons);
 2. Certified copies of federal and state income tax returns;
 3. Permanent employment in a position not normally filled by a student;
 4. Reliance on Massachusetts sources for financial support; and
 5. Former residency in Massachusetts and maintenance of significant connections there while absent.
- c. The following shall be secondary indicators of residency and shall be considered of less weight those listed in section b:

1. Continuous physical presence in Massachusetts during periods when not an enrolled student;
2. Military home or record; and
3. All other material of whatever kind or source which may have a bearing on determining residency.

Determination of Emancipation

Proof of Emancipation

A student asserting that he or she is an emancipated person shall furnish evidence to support such assertion. Such evidence may include:

- a. Legal guardianship papers - court appointment and termination must be submitted;
- b. Statements of the person, his or her parent(s), guardian(s), or others certifying no financial support;
- c. Certified copies of federal and state income tax returns filed by the person and his or her parent(s); or
- d. Where none of the foregoing can be provided, an affidavit of the emancipated person in explanation thereof and stating fully the grounds supporting the claim of emancipation.

Presumption, etc.

- a. Residency is not acquired by mere physical presence in Massachusetts while the person is enrolled in an institution of higher education.
- b. A person having his or her residency elsewhere than in Massachusetts shall not be eligible for classification as a

Massachusetts resident for tuition purposes, except as herein provided:

1. Any person who is registered as a UMass Lowell resident shall be eligible for continued classification as a Massachusetts resident for tuition purposes (until attainment of the degree for which he or she is enrolled) during continuous attendance at the institution.

2. The spouse of any person who is classified or is eligible for classification as a "Massachusetts resident" is likewise eligible for classification as "Massachusetts resident." This provision will not apply in the case of a spouse in the United States on non-immigrant visa.

3. A person who is an immigrant/permanent resident of the United States (or has applied for such status) is eligible to be considered a Massachusetts resident for tuition purposes provided that he/she meets the same requirements for establishing residency in Massachusetts as are required of a United States citizen. A non-citizen who is in (or has applied for) refugee/ asylum status is likewise eligible to be considered for Massachusetts residency for tuition purposes provided that he/she meets the same requirements for establishing residency in Massachusetts as are required of a United States citizen. A non-citizen must provide appropriate documentation to verify his or her status with the United States Immigration and Naturalization Service.

4. A student whose higher educational pursuits are funded by the Department of Welfare, the Massachusetts Rehabilitation Department, or any of the other Commonwealth of Massachusetts public assistance programs.

c. A person does not gain or lose in-state status solely by reason of his or her presence in any state or country while a member of the Armed Forces of the United States.

d. For the purposes of this policy the following persons shall be presumed to be Massachusetts residents:

1. A member of the Armed Forces of the United States who is stationed in Massachusetts on active duty pursuant to military orders, his or her spouse and dependent students; or

2. Full-time faculty, professional

staff, and classified staff employees of the University of Massachusetts system and their spouses and dependent students.

Appeals

Any student or applicant who is unwilling to accept the initial ruling relative to his or her residency classification may file a "Residency Reclassification Form."

Any student or applicant who is unwilling to accept the ruling related to his/her residency reclassification may submit an appeal to the University's Residency Appeal Committee. The decision by this Committee is final and may not be appealed further. In any case where the Admissions Office is unable to make an initial determination based on the evidence submitted, the applicant may be required to submit a "Residency Reclassification Form" to the Admissions Office for review before being finally classified as a resident or a non-resident.

Penalties

Misrepresentation in or omission from any evidence submitted with respect to any fact, which if correctly or completely stated would be grounds to deny classification as a Massachusetts resident, shall be cause for exclusion or expulsion from the University or other disciplinary action by the University.

Deadlines

Written appeal of an initial classification may be initiated at any time, although students are encouraged to submit such an appeal as early as possible. While initial classifications and reclassifications are normally effective for the term of the student's entry or reentry to the University, students may apply for reclassification during subsequent terms and will be evaluated for the semester in which the application is received.

New England Regional Student Program

Students who meet the eligibility requirements for residents of their state and admission requirements of a University program approved as a regional curriculum will receive preference in admission among out-of-state applicants and will be charged the in-state tuition plus 50% upon admission. It is assumed that students accepted into a program of study offered

under the New England Regional Student Program will remain in the same field of study. If a student subsequently transfers into a program which is not included in the regional student program, out-of-state tuition will be applicable as of the date of transfer. The same holds true for the inverse. The date of transfer into a regional student program is the effective date for the reduced tuition rate.

The following is a listing of programs of the University of Massachusetts Lowell which are presently offered under the New England Regional Student Program.

UMass Lowell Programs*	Eligible States
American Studies	RI, VT
Criminal Justice	NH, RI
Environmental Science	ME, RI
Health Education	RI, VT
Meteorology	ME, RI, VT
Music Business	CT, ME, NH, RI, VT
Nuclear Engineering	CT, ME, NH, RI, VT
Plastics Engineering	CT, ME, NH, RI, VT
Sound Recording	
Technology	CT, ME, NH, RI, VT

*This list of approved programs differs from that which has been approved for state colleges.

Financial Aid

The Office of Student Financial Assistance was established to provide students with the financial assistance necessary to reach their educational goals.

Financial aid consists of scholarships and grants (aid that does not need to be repaid), loans (money lent to a student that requires repayment during a specified period usually following the termination of University studies), and employment (self-help aid, Government or University sponsored on-campus work for all or a portion of an academic year).

Awards are made on a yearly basis and are dependent upon the availability of funding from specific sources, proven financial need, and the criteria of specific financial aid sources.

Please note that randomly selected financial aid recipients will be required to complete a verification booklet and return it with appropriate federal tax documentation and W-2's for both their parents and themselves to the Office of Student Financial Assistance.

University Administered Federal Assistance Programs

At UMass Lowell, aid is available to eligible students matriculated in a degree granting or approved certificate program who are U.S. citizens or have permanent visa status (green card I-151, I-551, or I-551C). Aid is granted for fall and spring semesters. In order to qualify for financial aid, all incoming and transfer students must file a Free Application for Federal Student Aid (FAFSA). This one form, which enables students to be considered for all types of assistance, is available in most high school guidance offices and college financial aid offices. Students are encouraged to apply as early as possible beginning January 1 and to be certain that the form is postmarked by no later than March 1.

Satisfactory Academic Progress

All students should be aware that the ultimate mandate under federal regulation require that in the absence of approved extenuating circumstances, a financial aid recipient who fails to meet the minimum institutional requirements of his or her program, following a period of warning and probation, is no longer eligible for any federal financial aid funds. Academic progress is reviewed yearly.

Pell Grant

Federal Pell Grants are awarded only to undergraduate students who have not yet earned a baccalaureate degree. Students must apply for the Pell Grant by completing the FAFSA form. The amount of the grant will depend on program funding and may vary from year to year.

Federal Supplemental Educational Opportunity Grant

A Federal Supplemental Educational Opportunity Grant is for undergraduates with exceptional financial need. Priority is given to Pell Grant recipients.

Federal Work-Study Program and Campus Work Program

Under these work-study programs, a student who meets established financial aid

criteria can be assigned part-time employment on campus. Students may work up to 22 hours per week while attending classes full time and may be employed up to 37.5 hours per week during vacation and summer periods.

Job Locator Program

This program offers part-time and summer employment for students with or without financial aid. It is available to provide off-campus jobs. Often students are able to find placement in their field of interest.

Federal Direct Loan Program

The Direct Loan Program enables students and parents to receive funds directly from the U.S. Department of Education to pay for education after high school. The Department is the lender, rather than a bank or credit union, and delivers loan proceeds through the student's school. Students and parents repay the Department of Education.

Federal Direct Subsidized Loans

The federal government pays the interest in these loans while students are in school at least half time and during certain other times, such as grace periods and deferments (postponements of repayment). Students must demonstrate financial need to receive this type of loan. Schools determine financial need based on the information provided on a financial aid application.

Federal Direct Unsubsidized Loans

Students may be awarded unsubsidized loans regardless of financial need but will have to pay all interest charges.

Federal Direct Plus Loans

A creditworthy parent, stepparent or legal guardian of a dependent student can borrow a PLUS loan to pay for their student's education. Parents are responsible for all interest charges.

Other Loans

Federal Perkins Loans

A Perkins loan is a long term low-interest (5%) federal loan where UMass Lowell is the lender. The loan is made with government funds with a share contributed by the school. Payment begins after the borrower ceases to be a student. Borrowers are advised that loans in default may be brought to litigation and court judgments sought.

MEFA Loans

MEFA loans are offered through the Massachusetts Educational Financing Authority. This is a program that is designed to assist families that have a student attending a college or university in Massachusetts. For further information, call MEFA at 1 (800) 449-MEFA (6332).

Special Student Loans

Office of Student Services

Limited, short-term loans are made to students to cover unexpected personal emergencies. These loans are to be repaid at a time specified by the loan note, which a student must sign at the time the emergency loan is granted.

Massgrant Scholarships

Massgrant Scholarships are awarded to undergraduate Massachusetts residents who apply when filing their FAFSA by May 1st; student must be a permanent resident of Massachusetts for a minimum of one year.

Scholarships and Awards

UMass Lowell offers Chancellor's Scholarships to new freshmen who are in the top 25% of their high school graduating class, have combined SAT scores of 1200 or above and have demonstrated need. These scholarships provide up to \$3,000 a year towards tuition and fees and \$2,000 towards room and board. This scholarship is renewable for a total of four years, if the student maintains a 3.0 cumulative average and continues to demonstrate financial need.

The following two programs, the **University Scholars Program** and the **Commonwealth Scholars Program** are renewed annually for a total of four years, if the student maintains a 3.0 cumulative average.

The **University Scholars Program** is a four-year scholarship offered to the first and second academically ranked high school seniors who are Massachusetts residents. A Principal recommendation and essay are required. This scholarship offers recipients up to \$8,000 towards the cost of their education, without regard to financial need.

The Commonwealth Scholars Program

is a four year scholarship that covers tuition, fees, room and board for Massachusetts residents without regard to financial need. High school seniors who have combined SAT scores of 1400 or above and are in the top 5% of their graduating class are eligible. In addition, transfer students with a 3.9 cumulative average and 30 or more transfer credits also qualify.

Alumni/Departmental Scholarships

are awarded annually to outstanding students. These are awarded to students who satisfy qualification requirements designated by their respective donors.

Please contact the scholarship office at (978) 934-4226 for additional information.



Academic Policies

Each University student is subject to two sets of academic regulations—those of the University as a whole, which are cited in this chapter, and the academic rules of the college and program in which he or she is enrolled. The academic rules of colleges and programs are listed in

chapters devoted to college programs.

In registering for courses, each student assumes full responsibility for knowledge of and compliance with the definitions, regula-

tions, and procedures for the University, as set forth in this publication. Moreover, in accepting admission to the University, each student assumes responsibility for knowledge of and compliance with the definitions, regulations, and procedures of the University pertaining to his or her student status as set forth in the appropriate University of Massachusetts Lowell publications and catalogue.

Students who have questions about the interpretation or application of University academic policy should consult the Dean of their College, the Registrar, or the Associate Provost. Please note that these policies are under continuous review and that the most up-to-date set are always published as "Yellow Pages" in each semester's schedule of classes book.

Baccalaureate Degrees

Undergraduate programs which are offered by the University of Massachusetts Lowell lead to one of the following degrees: Bachelor of Arts, Bachelor of Fine Arts, Bachelor of Liberal Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, Bachelor of Science in Engineering, Bachelor of Science in Engineering Technology, and Bachelor of Science in Industrial Technology.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree are designed to provide a broad, comprehensive education with many options for developing major and minor programs. These options are specified by each of the colleges offering Bachelor of Arts degree programs and are sufficiently flexible to satisfy the individual needs of students while also providing sufficient preparation in the major field for subsequent specialization at the graduate level. All Bachelor of Arts degree programs require completion of a major within the college in which the student is a degree candidate and (except as specified by policies concerning second majors) a minimum of 75 credits outside the major field. The following is a listing of major fields in which the Bachelor of Arts degree is presently offered by colleges of the University.

College of Arts and Sciences

American Studies

Art

Chemistry

Economics

English

Environmental Science

History

Modern Languages

Music

Philosophy

Political Science

Psychology

Sociology

Spanish

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide students with a broad scientific education with specialized training in one or more of the basic sciences (e.g., biological sciences, mathematics, meteorology, etc.) or to combine a general education with a specialized applied program (e.g., health education, nursing, the administration of criminal justice, etc.). Curricula which are offered in areas of the pure and applied sciences and mathematics provide opportunities for major and minor program options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula. All Bachelor of Science degree programs require completion of a major within the college in which the student is a degree candidate and a minimum of 50 credits outside the major field. The following is a listing of major fields in which the Bachelor of Science degree is presently offered by the colleges of the University.

College of Health Professions

Clinical Laboratory Sciences

Clinical Lab Sciences option

Medical Technology option

Exercise Physiology

Community Health Education

Nursing

College of Arts and Sciences

Atmospheric Sciences

Biological Sciences

Chemistry

Computer Science

Criminal Justice

Environmental Science

Geology option

Mathematics

Applied Math option

Pure Mathematics option

Computer programming option

Mathematical Statistics option

Meteorology

Physics

Applied Physics option

Optics option

Radiological Health Physics

Other Baccalaureate Degrees

Bachelor of Fine Arts, Bachelor of Music, Bachelor of Liberal Arts, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, and Bachelor of Science in Engineering degree programs have been determined by the requirements of specific career objectives and are subject to the recommendations of such professional associations as the National Association of Schools of Music and the Accreditation Board for Engineering and Technology. Course requirements for these professional degree programs are specified in terms of the total course of study and without reference to academic options which are available to students under Bachelor of Arts and Bachelor of Science degree programs.

General Degree Requirements

To qualify for University degrees, baccalaureate candidates are required to obtain 2.000 (C) averages in their total courses of study; to present a minimum of 120 semester credits; to fulfill the minimum residency requirement; to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating; to complete all curriculum requirements specified by the college in which they are enrolled and department(s) in which they are majoring; and to complete the University General Education requirements.

General Education Requirements for students enrolling prior to September, 2000

All students are required to satisfy the General Education Requirements, which include a minimum of 36 credits.

In fulfilling the following requirements (except Sciences), students may take no more than one course from a single

department. The two-course College Writing requirement is a separate service of the English Department and does not affect that department's participation in the other categories of general education.

Courses which are taken to satisfy the General Education requirements may not be taken on a pass-no credit basis, but must be graded.

Aesthetics: one course, three credits.

Behavioral and Social Sciences: two courses, six credits.

College Writing: two courses, six credits.

Historical Studies: one course, three credits.

Literature: one course, three credits.

Mathematics: one course, three credits (to meet required skill level).

Sciences: three courses, nine credits minimum, with at least two courses that include some form of experimental learning.

Values, Concepts, and Choice: one course, three credits.

General Education Requirements for students enrolling in September, 2000 and subsequently

The Faculty Senate has approved a new General Education Program, which will take effect for all undergraduate students enrolling in September, 2000, and subsequently. A detailed description of that new program will be published in the spring and summer of 2000.

Residency Requirements

All candidates for baccalaureate degrees, exclusive of category four below, must complete 60 semester credits at the University of Massachusetts Lowell. The following residency options apply, as specified, to candidates for baccalaureate degrees:

1. Complete three years in the University, earning not less than 90 credits, and an approved junior or senior year program at another accredited baccalaureate institution, earning not more than 30 semester credits or the number of semester credits

which is specified for juniors or seniors by those prescribed courses of study which are listed in this catalogue.

2. Complete an associate's degree at a Massachusetts community college under the provisions of the Commonwealth Transfer Compact and complete the last two years at the University, earning not less than 60 credits at UMass Lowell.

3. Complete up to the first two years in an accredited two-year institution, earning not more than 60 semester credits with grades of C (2.000 on a 4.000 scale) or better, and the remaining years in the University, earning not less than 60 semester credits.

4. Complete up to the first three years of a baccalaureate program in an accredited four-year institution, earning not more than 90 semester credits, with grades of C (2.000 on a 4.000 scale) or better, and the remaining year(s) in full-time study in University classes, earning not less than 30 credits.

An individual who has been admitted to day courses of the University as a non-matriculating (special) student is not considered a student in residence. If subsequently admitted as a matriculating student, such an individual must petition the college dean for recognition of non-matriculated courses. Up to 15 credits of non-matriculated day courses may be recognized for application to the minimum residency requirements of 30 semester credits of University courses.

Residency Requirement for Major Fields

Baccalaureate degree candidates must complete at least 15 semester credits within the academic department(s) in which he or she is majoring for each major which is presented for a degree. Upon the approval of the appropriate college dean, the course requirement of 15 credits within the major department may be satisfied through satisfactory completion of courses in the University of Massachusetts Lowell Continuing Education.

Dual Degree Program: Bachelor of Arts and Bachelor of Science in Engineering

Students who wish to pursue the dual degree program in the College of Arts and

Sciences and the College of Engineering must establish simultaneous matriculation in both colleges and designate candidacy for two degrees. The curricula for dual degree programs are approved by participating college faculties and must be completed as prescribed. It is therefore imperative that a student who wishes to pursue an approved dual degree program obtain a copy of the specified curriculum which enumerates the specific semester-by-semester course requirements. Students interested in this program should direct their inquiries to the office of the Dean of the College of Arts and Sciences or the Dean of the College of Engineering.

Major Field Requirements

Candidates for the Bachelor of Arts degree may not be required to take more than 45 credits in their major fields. Candidates for the Bachelor of Science degree may not be required to take more than 60 credits in their major fields. However, candidates for either degree may elect to take additional courses in the major beyond the specified maximum providing that such additional courses are not presented for the minimum degree requirement of 120 credits.

Declaration of Major

Students who have declared a major at the time of their admission to the University are officially enrolled in the college in which their designated major is offered and are referred by the college dean to the chairperson of the designated major for assignment of a faculty advisor.

Although the University does not require students to declare their major fields until they have achieved 60 semester credits, an early decision by students will greatly facilitate the selection of appropriate prerequisite courses for major fields and accordingly will reduce the possibilities of time-consuming errors in judgment.

Students enrolled in the College of Arts and Sciences are strongly encouraged to declare their major fields by the end of the freshman year. Students contemplating majors in chemistry or environmental sci-

ences should initiate prerequisite course work immediately upon entrance to the College of Arts and Sciences and should make a declaration of major at this time or prior to the end of the freshman year.

Students in the College of Health Professions should not delay declaration of major beyond the freshman year.

Additional course work beyond the minimum degree requirement and extension of the normal four-year period of study may be expected when individuals make a declaration of major later than recommended above.

Students who make no declaration of major prior to the end of their sophomore year are listed as undeclared students for their first two years. Individuals who wish to designate a major which is offered by the college in which they are enrolled as undeclared students must secure the signature of the appropriate department chairperson (or the chairperson of the committee which exercises jurisdiction over an interdepartmental major) on a declaration of major form and must file the completed form with the Office of the Registrar. Individuals who wish to designate a major which is not offered by the college in which they are enrolled as undeclared students must file an approved form for intercollegiate transfer and declaration of major with the Office of the Registrar. This form requires the signatures of the dean of the college to which the student transfers and the appropriate department chairperson.

Undeclared students are advised that openings may be limited or unavailable in some programs and that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments.

Students seeking professional advice regarding selections of majors, second majors, and minors should consult a college dean, a faculty advisor, or the Advising Center in the Centers for Learning, Southwick Hall.

Declaration of Second Major

Students who wish to declare a second major should consult with their college dean to determine if a second major can be completed within specified degree requirements or will require additional study beyond the minimum degree requirements and extension of the regular period of baccalaureate study. Students who wish to declare a second major in the college in which they are enrolled as degree candidates ordinarily may do so by filing an approved declaration of second major with the Office of Registrar. Students who wish to declare such a major in another college of the University may do so only when regulations of that college and the college in which they are enrolled as degree candidates both permit. Such declarations require the approval of both college deans. Students who are permitted to carry two majors are assigned an advisor in each major department.

Individuals who are matriculating for the Bachelor of Arts degree may not count more than 63 credits in the two academic majors combined toward the minimum degree requirement of 120 credits. Students who present more than 63 credits in the two majors combined may not present less than 57 semester credits outside the two major fields in satisfying the minimum degree requirement of 120 credits. Accordingly, students who present more than 63 credits in the two majors combined must present a number of credits beyond the minimum degree requirement of 120 credits which is equal to the number of credits by which they exceed the combined major credit maximum.

Except as noted under the heading "Dual Degree Program," students who elect academic majors in more than one college are candidates for one degree only; and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary by filing for intercollegiate transfer at the time they make a declaration of second major. Accordingly, a student who pursues academic majors in two colleges is subject to all degree requirements as specified by the college of his or her initial academic major and is subject only to major course requirements (including collateral and prerequisite courses for the major) as specified by the department of his or her sec-

ond academic major. Individuals who pursue double majors within different degree programs will receive the degree which is designated for their initial academic major unless they have filed for intercollegiate transfer when they filed a declaration of second academic major.

Professional programs in business administration, engineering, health education, clinical laboratory sciences, nursing, exercise physiology, industrial management, industrial technology and Bachelor of Music programs may be designated as degree majors only. Although students in these programs may be permitted to pursue a second major in an academic field which is offered by another college, they are subject to all degree requirements as specified by the college for the professional major.

Change of Major

Once students have begun a program of major studies, they may change their major field only by filing an approved change of major form with the Office of the Registrar. Students who make substantial changes in their plans of study after the beginning of the sophomore year, regardless of major, ordinarily will find it impossible to complete degree requirements within the normal four-year period of study and may also find it necessary to redesignate their choice of degree. Students who have been placed on academic warning should review their choice of major and should contemplate a change of program.

Change of Major within College of Enrollment

Students who wish to change their declarations of major within the college in which they are enrolled as degree candidates are required to file an approved change of major form with the Office of the Registrar. This form requires the approval of the chairperson of the major department to which the student desires to transfer and should be filed by November 1 for spring semester transfer and by April 1 for fall semester transfer in order to insure proper advising during the periods of fall and spring pre-registration. Filing after the recommended dates may be permitted by the chairperson of the

department having jurisdiction over the new major. Students anticipating a change of major may drop irrelevant courses if applicable University rules permit (cf. "Withdrawal through the 50th Class Day" and "Reduced Load Status"). The symbol X may not be assigned to courses which are dropped after the 50th class day because a student intends to change a major.

Change of Major with Intercollegiate Transfer

Students desiring to transfer from a baccalaureate continuing studies program to a baccalaureate day program, to transfer from a baccalaureate day program to a baccalaureate continuing studies program, or to drop a major which is offered by the college in which they are matriculating and to add a major which is offered by another college of the University must apply for intercollegiate transfer.

An individual seeking an intercollegiate transfer must file an academic petition and a transcript with the chairperson and dean having jurisdiction over the program to which transfer is desired. Following endorsement by both the chairperson and the dean, this form must be filed with the Office of the Registrar. Individuals petitioning for intercollegiate transfer are required to satisfy the admissions requirements of their desired college and program and, irrespective of any initial favorable decision concerning such petition, they will not be permitted to transfer if they have been suspended from the University after they have been accepted for transfer.

Individuals seeking transfer from one college to another are advised that openings may be limited or unavailable in some programs, that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments, and that the completion of degree requirements within the customary four-year period may not be possible since the correction of deficiencies cannot always be accommodated within the schedule of course offerings.

The official date of intercollegiate transfer is the first day of the semester following approval of a student's application. Since

course pre-registration is conducted prior to the official date of transfer, students should make immediate arrangements for pre-registration counseling with the dean of the college to which they will transfer. Subsequent to approval of a student's application for transfer and prior to the official date of transfer, the college dean shall review the academic record of the student to determine the applicability of previously completed courses to the requirements of the college and, if appropriate, the new major.

Minor Area Requirements

The requirements for minors are established by University departments or by interdisciplinary committees. No minor program may consist of less than 18 semester credits in the minor field nor more than 24 semester credits. At least six credits must be completed at the upper-division course level for all minor studies. Students are advised that an aggregation of courses which total 18 or more credits does not constitute a minor field. Specific options for minor programs will depend on the major field which a student has elected to pursue and collateral course requirements which have been specified by major departments. Although minor programs generally may be elected without specific authorization of departments offering such programs, some minors do require such authorization. In any event, individuals who are interested in electing a minor program should consult the relevant section of this publication for curriculum requirements and prerequisites. Only one minor program is officially noted on the student's permanent record.

Language Requirement

Although the University does not require language proficiency, as such, for any degree, each faculty having jurisdiction over specialized program areas has the prerogative of specifying a level of language proficiency as a collateral requirement for major fields. Students who are required to evidence intermediate proficiency as a collateral requirement of their major studies and individuals who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools may

satisfy intermediate language proficiency through any one of the following options:

- a. a score of 550 or above on a College Entrance Examination Board Achievement Test;
- b. a score of 3 or above on a College Entrance Examination Board Advanced Placement Examination;
- c. a satisfactory score in a proficiency test prepared and administered by the Language Department of the University of Massachusetts Lowell (preferably during the student's freshman year) and covering a reading knowledge of any one of the following languages: French, German, Greek, Italian, Latin, or Spanish;
- d. passing two semester courses on the intermediate, second-year college level in a language previously studied in the secondary school and offered by the University of Massachusetts Lowell; or
- e. passing a minimum of 12 semester credits in one language, the study of which is initiated at the University of Massachusetts Lowell.

Undergraduate Classification

Irrespective of the provisions of specific curricula and the number of full-time semesters completed by students, the University determines class standing on the basis of total credits earned (including AFROTC credits) and in accordance with the following scales:

Freshman standing	0-24 credits
Sophomore standing	24-54 credits
Junior standing	54-84 credits
Senior standing	84 or more credits

Maximum Period of Baccalaureate Study

Depending upon the nature of the subject and discipline, courses taken by a student may become obsolete for curricula of the University when they have been completed over a period of time which exceeds the customary period for baccalaureate study. Accordingly, University departments reserve the right to delete courses from a student's program of study when such courses have been determined to be

obsolete for the curriculum in which the student is enrolled.

Ten full-time semesters is the maximum period which is permitted for continuous University matriculation unless special permission for additional semester enrollment has been granted by the dean of the college in which a student is enrolled as a degree candidate. A student who fails to complete degree requirements within ten full-time semesters may be dropped from the University when instructional resources render it necessary to establish limitations upon enrollments.

Course Equivalency Examinations

The University recognizes two types of course equivalency for which credit is awarded. These are 1) CLEP examinations, and 2) departmental examinations. Restrictions, where applicable, are noted below.

Subject to specified policies of academic departments, unusually qualified degree candidates are given the opportunity to demonstrate their special competencies and to receive University credit for such competencies through established course equivalency procedures without having to fulfill classroom or faculty course requirements. Matriculating students may demonstrate their special competencies through subject examinations of the College Level Examination Program and through departmental equivalency examinations. Credits which are granted through course equivalency procedures are noted on the student's permanent record card. However, no grades for equivalency examinations are recorded and such examination credit as may be granted is not computed for determining grade-point averages.

The purpose of course equivalency procedures is to provide credit for existing competencies—that is, those competencies which students possess prior to their applications for equivalency credit and prior to their registration for a University course.

Students may not receive credit for a specific proficiency examination if they have registered at the University in the course which that examination represents, if they have previously received a University

grade for that course or a course in sequence above the course for which they wish to take the examination, or if they have previously attempted an equivalent course at another institution. Credit for general examinations of CLEP may not be granted to students after their admission to the University as matriculating students. University departments reserve the right to refuse the granting of credit by examination for those courses which are presented by a student for his or her major(s) and to deny recognition of previously granted credit for students who, prior to their declaration of major field, have received equivalency credit in the subsequently declared major.

Subject to the additional limitations of the college and program in which the student is enrolled, the maximum number of credits which a matriculating student may earn through course equivalency procedures is 30 semester credits. Students who have transferred to the University may not apply for equivalency credit in excess of a number which is determined by subtracting all course equivalency and transfer credits which are accepted by the University from the maximum of 90 credits which is permitted for both transfer and equivalency credit. Nor may transfer students present equivalency credits in fulfillment of the major field residency requirement of 15 credits in University courses.

College Level Examination Program (CLEP)

Students who are interested in taking subject examinations of the College Level Examination Program should secure petition forms from the Office of the Registrar which will permit matriculating students of the University to arrange for administration of CLEP tests. Approved forms must be filed with the Office of the Registrar. Application to take approved subject examinations of the College Level Examination Program may be made at the Division of Continuing Studies or other CLEP testing centers. Course credit through the subject examinations of CLEP will be granted only if an examination has been approved by an individual's faculty advisor and the chairperson of the department which offers the course for which the CLEP test is a substitute and the score attained by the individual is equal to or

better than the minimum score for an examination specified in the table below.

Although students are advised to secure the above authorization prior to taking a CLEP test in order to avoid rejection of a request for credit after a test has been taken, such authorization may be solicited after completion of a test. CLEP tests in subjects not listed below will not be recognized for University credit. The following is a list of CLEP tests for which credit will be granted.

	test score	earned credit
Accounting, Introductory	47	6
Afro-American History	49	3
American Education, History of	46	3
American Government	47	3
American History	46	6
American Literature	46	6
Biology, General	46	6
Business Law, Intro	51	3
Calculus, Elem Functions	47	6
Chemistry, General	47	6
College Algebra	45	3
College Algebra & Trig	45	3
College Composition	47	3
College French (1 & 2)		
Second Semester	41	6
Fourth Semester	53	12
College German (1 & 2)		
Second Semester	40	6
Fourth Semester	48	12
College Spanish (1 & 2)		
Second Semester	41	6
Fourth Semester	50	12
Comp & Data Process	47	3
Computer Programming		
Elementary - FORTRAN IV	48	3
Educational Psychology	46	3
English Literature	46	6
Human Growth & Dev	45	3
Lit - Analysis & Interp	49	3

Macroeconomics, Intro	48	3
Microeconomics, Intro	47	3
Psychology, General	47	3
Sociology	48	3
Trigonometry	50	3
Western Civilization	50	3
Western Civilization	50	3

Departmental Examinations

Students who are interested in taking departmental examinations may obtain applications for such examinations from the Office of the Registrar at any time during the fall and spring semesters, but they must initiate the application process in sufficient time to permit the completion of examinations and the processing of examination results prior to the final deadline for filing course grades during the semester in which they are examined.

Applications for departmental course-equivalency examinations are filed with the chairperson of the student's major department, the chairperson of the department in which the examination is to be administered, and the faculty examiner.

Students may not repeat departmental equivalency examinations and, except for documented medical reasons or personal emergencies, they may not reapply for such examinations in the event that they fail to keep an examination appointment. Examinations must be wholly or substantially written unless the nature of the course makes more appropriate an oral or performance examination. Departments may authorize instructors to administer end-of-semester examinations which are scheduled during the final examination period when such examinations are adequate measures of total course requirements. After the student has completed an authorized examination, the faculty examiner must file his or her recommendation for course credit with the Office of the Registrar by the final deadline for filing semester grades.

Programs of Study and Declarations of Intent to Graduate

All students are required to file with their advisor a copy of their final semester course registrations (including notification

of course withdrawal) and an accurate account of courses taken, grades received, and changes of contemplated programs of study. Deadlines for conferring with faculty advisors concerning the completion of degree requirements and for filing final programs of study and declarations of intent to graduate with college deans are specified by the University calendar.

Each college has adopted a program of studies form which best reflects the nature of its degree programs. Forms which are employed by the College of Arts and Sciences and the College of Health Professions have been standardized and designate three areas: University General Education requirements, major requirements, and collateral programs (second majors, minors, and unrestricted elective courses).

Credits for each course may be counted only once in a student's program of studies form and may not be counted for more than one category of the program of studies (courses and credits in the human values requirements of the University General Education curriculum may be used to fulfill this requirement and another requirement in the student's curriculum but may not be counted twice in satisfying the overall credit hour requirement for the curriculum). A course which is specified as a requirement for both a student's major and minor will satisfy both requirements, as stated, but course credits may not be counted more than once and may be applied to one category of a student's program of studies only.

At the end of the semester following the filing of a declaration of intent to graduate, the college dean verifies course completions and required cumulative and major averages. The names of students who have satisfied all degree requirements are then forwarded to the appropriate college faculty for endorsement and, finally, to the Office of Academic Affairs, which orders appropriate diplomas for conferral at graduation. Students who unofficially complete all degree requirements and fail to file a declaration of intent to graduate or a program of studies shall not be recommended to the Office of Academic Affairs and the conferral of the degree shall be delayed until an approved declaration has been filed.

University Commencement

Graduation exercises are held once a year at the end of the spring semester. Undergraduates who have completed degree requirements during the previous summer term or fall semester are permitted to attend commencement exercises and their names are listed in the commencement booklet. Attendance of commencement exercises is not compulsory, but all seniors are required to pay the specified graduation fee, which covers the cost of the diploma, academic attire, and incidental graduation expenses. An individual who wishes to receive a diploma by mail must file a corrected address with the Office of the Registrar if he or she anticipates moving from a previously reported permanent address.

Conferring of Degrees

Diplomas are awarded three times a year: 1) in June for students completing degree requirements during the spring semester, 2) in October for students completing degree requirements during the summer term, and 3) in February for students completing degree requirements during the fall semester. Individuals who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the awarding of diplomas may obtain a letter of completion from their college dean. Duplicate diplomas are not issued for any reason.

Academic Honors

Academic honors are of three types: University honors, honors in major fields, and dean's list (semester honors). Undergraduate students may qualify for University honors and the dean's list. Honors in major fields are available at the option of the major departments.

University Honors

The University recognizes baccalaureate graduates who have attained exceptional scholastic distinction. To be eligible for such recognition a student must achieve a minimum grade point average of 3.000 for all courses completed at the University and must have earned a minimum of 60 semester credits at the University as upperclass students. Additionally, each student must achieve a grade-point average which falls within the range of averages specified by each college for the levels of distinction.

Three levels of distinction are noted at commencement: summa cum laude, magna cum laude, and cum laude.

University honors are officially entered on the permanent record of students.

Honors in Major Fields

In addition to honors which are awarded by the University, honors in major fields may be awarded by the colleges in which students are enrolled or (in the case of Continuing Studies students) by the colleges which exercise academic jurisdiction over the program in which they are enrolled. Recommendations for such honors are made by the faculty of the student's major department (or by interdisciplinary committees which exercise academic jurisdiction over the student's major studies) for outstanding achievement in the major field. In order to qualify for such honors, the student must fulfill the following requirements:

- complete a minimum of 24 credits in the major field at the University of Massachusetts Lowell;
- fulfill any honors requirement as specified by colleges, departments, or interdisciplinary committees in the major field; and
- achieve a grade-point average as specified below.

High Honors

4.000 in all courses which are taken in the major field at the University of Massachusetts Lowell.

Honors

3.500 to 3.999 in all courses which are taken in the major field at the University of Massachusetts Lowell with no course grade in such courses less than B.

Honors in the major field are not noted on the permanent record cards of students.

Dean's List (Semester Honors)

At the end of the fall and spring semesters, the dean of each college issues a list of undergraduate students who have achieved distinguished semester records. This list recognizes students who have completed full-time programs (at least 12 credits of which must have been qualitatively graded) with no grade less than B.

Grading Policies

The following qualitative letter grades are employed by faculty members to characterize the quality of a student's work in a course: A, AB, B, BC, C, CD, D, and F and respectively carry quality points of 4.000, 3.500, 3.000, 2.500, 2.000, 1.500, 1.000, and 0.

A designates that the work done by the student is superior and is of the highest honors quality;

AB designates that the work done by the student is less than superior but is completed with the level of distinction which is higher than the basic honors level;

B designates that the work done by the student is of basic honors quality;

BC designates that the work done by the student is less than honors quality but is better than satisfactory;

C indicates satisfactory work which conforms to the general expectations of the University for baccalaureate study;

CD indicates that the work done by the student is less than satisfactory and below graduation standard but is better than the minimum requirement for passing a course;

D indicates work which meets the minimum requirement for passing a course;

F designates course failure.

In addition to the above qualitative letter grades, the following symbols are used to designate special enrollment provisions or course statuses and do not affect the student's academic average:

P designates completion with credit of an unrestricted elective or physical activities course which was taken on a pass-no credit basis;

NC indicates failure of an unrestricted elective which was taken on a pass-no credit basis;

S designates satisfactory completion of a practicum experience course with a final course grade of C or higher;

U indicates unsatisfactory performance in a practicum experience course with a final course grade of less than C;

I indicates a course which has not been completed;

AU designates that the student has registered for a course on an audit basis and has maintained an attendance record throughout the semester which is sufficient to warrant an official recognition of course attendance;

W designates student withdrawal from the University prior to the 41st class day of a semester or from a course during the period from the 10th to the 40th class day;

X designates student withdrawal after the 40th class day of a semester for administratively approved reasons of an emergency or medical nature; and

Y designates administrative dismissal for other than academic reasons.

Pass-No Credit Course Registration

Students may elect to register on a pass-no credit basis for a maximum of four unrestricted elective courses. A student may not change his or her enrollment status from letter grade to pass-no credit or from pass-no credit to letter grade after the established deadline for adding a course. A pass-no credit course cannot be presented in fulfillment of University General Education requirements, major programs, minor programs, or specifically

designated courses (collateral requirements) of an established curriculum. A grade of P indicates that a student's performance merits an evaluation of D or better. NC indicates that a course has been failed but that such failure is without prejudice to the student's cumulative average. Although appropriate credits are granted to students when grades of P have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average. The entry NC will not keep an otherwise qualified student from dean's list recognition.

Satisfactory-Unsatisfactory Course Registration

Certain courses (e.g., practicum experiences, advanced seminars, and directed studies) may be graded as satisfactory or unsatisfactory. A grade of S indicates that a student's performance merits an evaluation of C or better. U indicates a course evaluation of less than C. Although appropriate credits are granted to students when grades of S have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average. A grade of U indicates that attempted course credits have not been granted and is awarded without prejudice to a student's cumulative average.

Incomplete Courses

The letter symbol I (incomplete) is a temporary notation which is assigned for incomplete work in courses when the records of students justify the expectation that they will obtain a passing grade but for emergency reasons they have been absent from the final course evaluation. Any missed final examination or other final course evaluation requires a student explanation within 48 hours so that the instructor can file the proper course notation with the Office of the Registrar.

A student who has evidenced an unsatisfactory course record, who has failed to complete a major portion of an instructor's course requirements, or who fails to provide an instructor with a satisfactory reason for absence from a final examination or final course evaluation within the specified 48 hour period may not be assigned the letter symbol I.

Responsibility for making arrangements with an instructor to complete all outstanding course work rests entirely with the student, who must complete all course work in sufficient time to permit an instructor to file a final course grade no later than one month after the date on which the succeeding semester begins.

Instructors who file letter symbols of I also must file an end-of-course letter grade which will be assigned in the event that incomplete course work is not made up by the student prior to the established deadline. At the end of the official make-up period (or, in the event of a substantiated student emergency, at the end of an extended make-up period), the Registrar will convert the temporary notation of I to the appropriate permanent symbol. This permanent notation will be one of the following: 1) a letter grade which has been filed by an instructor during the grading period of the previous semester to designate the final course standing of a student who has failed to make up incomplete course requirements, 2) a letter grade which is filed by an instructor at the end of the make-up period to designate the final course standing of a student who has made up incomplete course requirements, or 3) the letter symbol of X which the dean of the college in which the student is enrolled as a degree candidate may authorize to designate that a student has withdrawn from the University after the end of the semester for documented medical or personal emergency (cf. "University Withdrawal After the End of the Semester").

Limited extensions of the make-up period may be granted to students for serious medical reasons and for documented personal emergencies. Requests for such extensions are approved by the dean of the college in which students are enrolled as degree candidates and must be filed no later than one calendar week preceding the established deadline for instructors to submit final grades for incomplete courses. Except for extraordinary circumstances acceptable to a college dean, the maximum period for which an extension may be granted is the last scheduled class day of the semester following the assignment of I notations.

Audited Courses

A student may enroll in credit courses as an auditor with appropriate approval. Forms and instructions for registration as an auditor may be obtained from the Office of the Registrar. No charge is levied on full-time students for audited courses. No credit or grade will be recorded for an audited course, but the symbol AU will be listed on the permanent record card. A change from audit to credit status, or from credit status to audit, may not be made after the deadline for adding a course (tenth class day).

Credit may not be earned in courses which have been audited except by re-enrollment in and completion of the course with a passing grade. Students who have audited a course subsequently may not earn credit in the same course through tests of the College Level Examination Program or through other authorized examination procedures for course challenge.

Grade Changes

At the end of each semester, the Office of the Registrar mails a grade report to each student. This report constitutes official notification of grades received. All course grades become a part of the student's official record upon instructor assignment and may not be changed except as specifically provided by University procedures. Corrections of grade-point averages automatically are authorized when erroneous grade reports are corrected by instructors and when specific courses are deleted from grade-point averages under provisions of University regulations governing repeated courses and course deletions.

Students who believe that a mistake has been made in assigning or recording a course grade should notify instructors as soon as possible after receiving their grade reports but in no case at a time later than the deadline established for making grade corrections. The deadline for instructors to correct an erroneous grade report is one calendar month from the beginning of the semester following the filing of an erroneous grade. Changes of grades other than the filing of grades for incomplete courses require the endorsement of the appropriate college dean. Grade changes may not be made on a stu-

dent's permanent record card after the deadlines cited above unless such changes have been authorized by appropriate college deans prior to the expiration of the correction deadline. Accordingly, students who experience difficulty in contacting faculty members for the purpose of questioning assigned grades should consult the appropriate college dean prior to the expiration of the correction deadline.

Withdrawal from Courses

W and X are administrative symbols which indicate that a student has been authorized to withdraw from courses, or from the University. These symbols, which are entered upon the student's permanent record card without prejudice, may be authorized only in accordance with established policies of the University and only upon student request.

Course Withdrawal Through the 50th Class Day

Students who desire to withdraw from courses with notations of W during the period from the 11th to the 50th class day of a semester must file these forms with the Office of the Registrar no later than the 50th class day. Students who do not complete the process of withdrawal by the 50th class day will not be assigned course notations of W, will be subject to all instructor course requirements, and will receive final course grades.

Since such unforeseen circumstances as late trains, automobile breakdowns, and faculty absences unexpectedly may extend the period during which a student has planned to complete the withdrawal process, a student who delays his or her course withdrawal until the end of the withdrawal period may discover that it is impossible to comply with the withdrawal deadline of the 50th class day.

Students who withdraw from all courses are required to withdraw from the University. Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full- or part-time levels which they have reported to the Veterans Administration.

Course Withdrawal After the 50th Class Day

Course withdrawal after the 50th class day of a semester ordinarily requires withdrawal from the University but partial withdrawal may be authorized for reason of extended illness or critical personal emergency.

1. The student shall present an academic petition to the Associate Provost which identifies the course(s) from which the student seeks to be withdrawn.
2. Along with the petition, the student shall present appropriate, verifiable documentation which is corroborative of the reason for withdrawal advanced on the petition.
3. Partial withdrawal will not be authorized because a student anticipates a low or failing grade in the course or because of the presumed effect of a low or failing grade on the student's cumulative grade-point average.
4. The student who fails to complete course withdrawal procedures before the first day of the final examination period will be denied permission to withdraw from a course and accordingly will be graded. Exceptions to this policy may be granted for verified extraordinary circumstances by the Associate Provost.
5. Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full- or part-time levels which they have reported to the Veterans Administration.

Withdrawal from the University

All students who desire to withdraw from the University are required to 1) discharge all financial obligations to the University, 2) return all University property, and 3) file a written notification of withdrawal with the Office of the Registrar. Since the date of official withdrawal as recorded by the Office of the Registrar is one basis of any claim for tuition refund, and may be of importance in determining subsequent legal or student insurance claims, students should process withdrawal papers in person prior to leaving the University.

Students who absent themselves from the University without officially withdrawing will remain on class rosters until they offi-

cially withdraw from the University or until the end of the semester. Students who remain on class rosters after the 50th class day will be assigned final course grades. The date on which a withdrawal request is filed with the Office of the Registrar is the date on which withdrawal is academically effective and constitutes the basis for final course notations.

The names of students who have withdrawn from the University for any reason are removed from all rolls. Students who have withdrawn must be reinstated. This is accomplished only through the office of admissions.

Students who are recipients of benefits from the Veterans Administration may not process withdrawals from the University which violate their declarations of classroom attendance. Recipients of veterans benefits are advised that they must receive course grades when their requests to withdraw from the University have been filed after deadlines of the Veterans Administration for processing changes of declared benefit status or when their dates of withdrawal will conflict with declarations of classroom attendance.

University Withdrawal Through the 50th Class Day

Students who register for courses and who withdraw from the University prior to the first day of classes of a semester are withdrawn without record. Students who register for courses and who withdraw from the University from the 1st to the 50th class day of a semester are withdrawn with course notations of W.

University Withdrawal After the 50th Class Day

A student who withdraws from the University during the period from the 51st class day to the end of the semester must be graded by all course instructors unless the student is authorized to withdraw for documented reasons of extended illness or critical personal emergency. A student who wishes to withdraw from the University after the 50th class day of a semester for such reasons must file an academic petition, together with appropriate documentation, with Associate Provost. Following a review of the aca-

demetic petition and verification of attached documentation, the Associate Provost may permit the student to withdraw from all courses.

University Withdrawal After the End of the Semester

A student who has unofficially withdrawn from the University (i.e., has ceased attending classes) for reasons of extended illness or critical personal emergency and has been unable to officially withdraw from the University before the end of the semester may petition to withdraw from all courses with symbols of X. Such a student must file an academic petition, together with supporting documentation, no later than one calendar month from the beginning of the following semester. This petition must be filed with the Associate Provost. Following a review of the academic petition and verification of attached documentation, the Associate Provost shall notify the student and the Registrar of the decision.

A student who has been the recipient of benefits of the Veterans Administration may petition to withdraw from the University after the end of the semester only when he or she has been provided with written authorization from the Veterans Administration.

Administrative Dismissal from the University

A student may be administratively dismissed from the University through cancellation of registration for due cause, through suspension or expulsion for academic dishonesty (cf. "Academic Dishonesty, Cheating, and Plagiarism"), and through disciplinary procedures for violations of good conduct. For information concerning procedures which govern violations of campus conduct, refer to the section "Student Disciplinary Procedures" in this catalogue.

Administrative dismissal may be invoked when a student fails to comply, after due notice, with an administrative regulation of the University. Official notification of an administrative dismissal is noted on the permanent record card by the symbol Y, which is entered for each course which has been carried by the dismissed student.

Reinstatement of a student who has been administratively dismissed may be made only by application for readmission with the Office of Admissions and only when the condition which has necessitated administrative dismissal can be ameliorated to the satisfaction of University officials. Examples of some conditions which may justify administrative dismissal are as follows:

- a. forgery or fraudulent use of University records, documents, or forms; unauthorized entry into University records (including computerized records);
- b. non-payment of tuition, board, room charges, student fees, library fines, overdue University loans, and other official University fiscal obligations;
- c. failure to comply with a duly authorized administrative order relating to the safety of persons or the protection of University property;
- d. failure to submit necessary health forms as required by University Health Services; and
- e. failure to withdraw from the University after certification of a physical health or mental health condition of a hazardous nature.

Academic Dishonesty, Cheating, and Plagiarism

The following definitions are provided for the information of all students and constitute official notice of prohibited academic practice and behavior.

1. Cheating is defined as 1) misrepresenting academic work which has been done by another as one's own efforts-whether such misrepresentation has been accomplished with or without the permission of the other individual, 2) providing or utilizing prohibited assistance (whether in the nature of a person or a resource) in the performance of assignments and examinations, 3) copying of another person's work or the giving or receiving of information or answers by any means of communication during an examination, 4) utilization of the services of a commercial term paper company, and 5) the unauthorized or fraudulent acquisition and/or use of another's academic property.

2. Plagiarism is defined as 1) direct quotation or word-for-word copying of all or part of the work of another without identification or acknowledgment of the quoted work, 2) extensive use of acknowledged quotation from the work of others which is joined together by a few words or lines of one's own text, and 3) an abbreviated restatement of someone else's analysis or conclusion, however skillfully paraphrased, without acknowledgment that another person's text has been the basis for the recapitulation.

Obligations of Faculty Members to Students

Although each student is responsible for complying with the above notice of prohibited practice and behavior, faculty members are responsible for publishing their special requirements for completing assignments and taking examinations. Such requirements must be explicitly made through the published statement of course requirements or through examination and assignment directions.

Preservation of the integrity of the academic process is an exercise of professional judgment and is both a faculty right and a faculty duty. The rendering of a professional judgment when charging or adjudicating an academic offense must be honest and equitable and must ensure due process, including notification to the student of the particulars of a charge of academic dishonesty and the penalties which will be imposed or recommended.

In assessing penalties for academic dishonesty or prohibited academic practice and behavior, faculty members and designated authorities of the appeal process should consider the nature of the offense, the question of premeditation, and any previous record of dishonesty or violation of prohibited practice and behavior. Neither the student nor the University can be served when the punishment is not proportionate to the offense.

Process of Notification and Adjudication

Depending upon the circumstances of time and place when academic dishonesty has been detected and the severity of penalty which the faculty member wishes

to impose, notice to the student concerning alleged dishonesty and/or violation of prohibited academic practice and behavior may be provided through either a formal or informal procedure. Should the faculty member* fail to notify the student of a charge of academic dishonesty and/or prohibited academic practice and behavior through either an informal verbal notification of charges or a formal written notification of charges, no penalty may be imposed.

*When a faculty or department committee is responsible for evaluating student work for a course (e.g. Senior Studio Review Committee, Department of Art), instructor notification shall be provided by the committee chairperson.

Informal Procedures

The informal notification procedure may be used only in the following instances: 1) in cases of observed cheating or observed violation of testing or classroom assignment requirements; 2) in cases of reported cheating or violation of classroom testing or assignments, detected plagiarism, or other cases occurring prior to the final examination in which the commissions and detection of academic dishonesty are not coincident; and 3) in cases for which the recommended penalty, per se, is less than course failure.

The informal notification procedure may not be used for offenses which are detected during or after the administration of the final course examinations or (in the event that no final examination is administered) after the last class of a semester and may not be used if the faculty member wishes to impose penalties which range from course failure to suspension from the University.

In cases of observed cheating, the informal procedure includes verbal notification to the student prior to the end of the examination or class period and appropriate written comment on the student paper which shall include a statement of the penalty to be imposed. In those cases wherein the commission and detection of academic dishonesty are not coincident, the faculty member shall provide notification by making an appropriate written comment on the paper or assignment which shall include a statement of the

penalty to be imposed.

Within three class days of notification, the student may request a meeting to discuss the charge and the penalty specified, and the faculty member shall schedule such meeting. The purpose of the informal meeting is to clarify possible misunderstandings between the student and the faculty member, to discuss the impact of the proposed penalty upon the student's final grade, and to pursue any question relative to the charges and penalties. At this meeting, or within three class days of this meeting, the student shall advise the faculty member that he or she accepts the charge and penalty proposed or that he or she will initiate a formal appeal with the department chairperson. If the student does not initiate a formal appeal, the charge may not be challenged and the penalty may not be appealed. In the event that a formal charge of academic dishonesty is initiated by a department chairperson, the chairperson shall be replaced in all stages of the appeals procedure by a senior faculty member of the department in which the violation is alleged to have occurred.*

*In the event that all members of the department have served on the department committee which has initiated charges against a student and the chairperson of such department committee also is the chairperson of the department, the appeal process shall begin with the college dean.

Formal Procedures

The formal procedure for notification and adjudication must be used in the following instances:

- 1) in cases of observed cheating or violation of testing procedures during the final examination;
- 2) in cases of cheating or plagiarism which are detected after the final examination; and
- 3) in cases for which the recommended penalty ranges from course failure to expulsion.

In each of the above cases, the faculty member shall provide the student with formal written charges of alleged dishonesty or violation of prohibited academic prac-

tice or behavior. During periods when classes are in session, such charges either shall be given to the student in person or shall be sent to the student's campus mailbox. During periods when classes are not in session, such charges shall be sent to the student at his or her official home address of record by registered mail (return receipt requested).

Notification shall be given to the student or mailed within three class days + of the time when the faculty member became aware of the alleged student offense or by the last day for filing semester grades with the Office of the Registrar, whichever is earlier. A copy of written charges shall be forwarded to the department chairperson, the chairperson of the college academic standards committee, and the college dean.#

+The term "class day" is defined as any day when classes and final examinations are scheduled. It also applies to days when University offices are open during the week which immediately precedes the first scheduled day of semester classes. In extraordinary circumstances, the college dean may authorize extensions of deadlines and may authorize the scheduling of hearings during periods other than the regular academic year.

#The terms "department chairperson," "college dean," and "college academic standards committee" refer, respectively, to the designated officials and committee of the college in which the concerned course is offered.

A formal adjudication of a charge of academic dishonesty also may be initiated by a student on appeal from the procedure of informal adjudication and discussion. In such case, the faculty member shall provide a formal written statement of charges to the student, the department chairperson, the chairperson of the college academic standards committee, and the college dean within two class days of the student's notification of intent to appeal.

Within seven class days of receipt of a formal notification of academic dishonesty, the department chairperson shall hold a meeting with the faculty member and the student to discuss the charges and recommended penalty. At the end of the meeting, the department chairperson shall noti-

fy the parties of his or her judgment. If there is no further appeal, the chairperson's decision shall be final.

Either the student or the faculty member may appeal the chairperson's decision to the college academic standards committee. This appeal must be made within three class days of the chairperson's decision. The academic standards committee shall meet with the department chairperson, the faculty member, and the student within seven class days of receipt of requested appeal. Within three class days, the academic standards committee shall notify the concerned parties of the decision.

If there is no further appeal, the committee's decision shall be final.

Either the student or the faculty member may appeal the decision of the college academic standards committee to the college dean. This appeal must be made within three class days of the committee's decision. The college dean shall meet with the chairperson of the college academic standards committee, the department chairperson, the faculty member, and the student within seven class days of the requested appeal. Within three class days, the college dean shall notify the concerned parties of his or her decision. The decision of the college dean shall be final and, hence, may not be appealed.

Right of Student Counsel at Hearings

A student who has been formally charged with an academic offense may request representation from the Office of Student Services, the counseling staff, or the full-time faculty to provide aid and assistance at any stage of formal hearings. Such counsel shall be provided with copies of documents which have been forwarded to hearing authorities and he or she shall be present for all formal hearings. Legal counsel may be present for either the student or the University but may not participate in hearing deliberations.

Special Provisions

While an appeal process concerning an academic offense remains unresolved, the charge shall not prejudice the right of a student who has not otherwise been suspended for unsatisfactory academic per-

formance or student misconduct from continuing his or her course of study at the University.

The timetables which have been specified above for the conduct of appeal processes have been developed to insure the speedy resolution of both the charges and the student's University status. In the event that resolution of a charge of academic dishonesty cannot be made prior to the beginning of next semester and a charge of academic dishonesty is subsequently sustained and the penalty imposed either requires or results in suspension, the student shall be dropped from the University immediately and accordingly may not be permitted to complete courses for which he or she may have registered.

A party to an appeal hearing who is unable to attend his or her hearing as scheduled must notify the appeal authority as soon as possible, preferably one day in advance. An individual may be excused from attendance and may be granted a second hearing for good and sufficient reason acceptable to the appeal authority.

Except that the penalty of suspension or expulsion from the University shall require the concurrence of the college dean, an appeal authority at any level may resolve a charge of academic dishonesty and/or may impose a penalty without recourse to subsequent hearings, if, without prior notice, the appealing party has failed to appear as scheduled for an appeal hearing.

A party of an appeal hearing who was unable to provide prior notice of his or her inability to attend an appeal hearing as scheduled may submit an academic petition to the college dean requesting a rehearing before the appropriate authority. The college dean may grant a rehearing for reasons of serious illness, accident, critical personal or family emergency, or other such acceptable reasons, and his or her decision concerning a rehearing shall be final.

Penalties for Academic Dishonesty or Prohibited Academic Practice and Behavior

Except as noted below, penalties for academic dishonesty or prohibited academic practice and behavior which are adjudicated through the informal procedure are lim-

ited to 1) the administration of an alternative assignment or substitute examination which shall be at the sole discretion of the faculty member, and 2) failure of an examination or assignment and denial by the faculty member of permission for the student to withdraw from the course before the 50th class day.

Penalties for academic dishonesty or prohibited academic practice and behavior, which are adjudicated through the formal procedure (including cases appealed by the student from an informal adjudication), may range from the administration of an alternate assignment or substitute examination at the sole discretion of the faculty member, failure of an examination or assignment (and the consequent lowering of final course grade) through course failure (including denial of permission to withdraw from the course in question before the 50th class day) to academic suspension or dismissal from the University.

The penalty of academic suspension, which may be imposed for a new semester or academic year, and the penalty of dismissal from the University (expulsion), which shall be permanent, may be imposed only by the college dean. In the event that the dean of the college in which an academic offense has taken place shall approve or impose either

a penalty of academic suspension or dismissal (expulsion) from the University upon a student who is matriculating for a degree in a college other than that in which the academic offense has taken place, the imposition of such suspension or dismissal shall require the concurrence of the dean of the college in which the student is matriculating. If the deans do not concur, they shall arrive at a mutually agreeable penalty and such decision shall be final.

The semester grade filed by a faculty member for a student who is the subject of an unresolved or pending allegation of academic dishonesty shall be an Incomplete, with an end-of-course letter grade which shall be assigned in the event that the student makes no appeal or the charge is sustained through appeal and the penalty is reaffirmed. If the determination of penalty which is made at the last step of the appeal process, as invoked, is differ-

ent from that which was initially made, the faculty member shall file a correction of the final grade which is in compliance with the final determination.

Special Procedure for Penalties Relating to Legal Professional Licensure and/or Certification

The implication of academic dishonesty or violation of prohibited academic practice and behavior for ethical standards which are specified by law for professional licensure and/or certification are questions which properly reside with professional review bodies. Hence, a decision concerning student continuance or discontinuance in a professional program which requires legal licensure or certification shall not be made by an individual faculty member or by designated authorities of the appeal process defined above.

Following the imposition of a penalty by a faculty member or by designated authorities of the appeal process defined above for academic dishonesty, the status of a student who is enrolled in professional program which requires legal licensure or certification may be reviewed by an established professional review body. If, in the opinion of the professional review body, the nature of the academic violation warrants discontinuance of the student's enrollment in the professional program, it shall so notify the student, who either shall withdraw or shall be dropped from the professional program. The decision of a professional review body is final and may not be appealed to the college dean.

Academic Standing

Academic standing and eligibility for a degree are determined by the quality of the student's course work.

Determination of Academic Standing

To ascertain the student's academic standing, the University uses a point system, each qualitative grade having an equivalent numerical value.

A	=	4.000
AB	=	3.500
B	=	3.000
BC	=	2.500

C	=	2.000
CD	=	1.500
D	=	1.000
F	=	0.000

Quality points are computed by multiplying the number of course credits by the numerical value of the qualitative grade assigned. For instance, a three-credit course with a grade of BC would carry 7.500 quality points (3 x 2.500). Grade-point averages and cumulative grade-point averages are obtained by dividing the number of quality points earned by the number of quality hours attempted.

Specified grade-point averages are computed solely on the basis of those courses attempted at the University of Massachusetts Lowell which have been qualitatively evaluated with the following letter grades: A, AB, B, BC, C, CD, D, and F.

All students are required to maintain at least a 2.000 average throughout their academic career. Academic records are evaluated at the end of each semester. No student, however, will be academically suspended without having at least one semester of academic notice or academic warning.

The academic status of a student is one of the following six categories:

Satisfactory Academic Standing

Indicates that the semester grade-point average is at least 2.000, and the cumulative grade-point average is at least 2.000.

Academic Notice

Indicates that: a) the semester grade-point average is less than 2.000 but the cumulative grade-point average is at least 2.000; or b) a "low-credit student" (one who has attempted fewer than 21 credit hours) has a cumulative grade-point average of at least 1.700 but less than 2.000.

Academic Alert

Indicates that a low-credit student (one who has attempted fewer than 21 degree credits) has a cumulative grade-point average below 1.7000.

Academic Warning

Indicates either: a) the cumulative grade-point average is below 2.000; or b) the semester grade-point average is below 2.000 but the cumulative grade-point average is at least 2.000, and the student had been on Academic Notice, Alert, or Warning at the end of the previous semester.

Academic Suspension

Indicates that the student was on academic notice or warning at the end of the previous semester and the cumulative grade-point average is below 2.000.

Academic Probation

Indicates that the student was readmitted after an academic suspension.

Academic Dismissal

Indicates that a student was on academic probation and failed to achieve satisfactory academic standing during the probationary semester.

Changes in Academic Standing

1. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.000 but whose cumulative grade-point average is at least 2.000 is placed on academic notice.

2. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.000 and whose cumulative grade-point average is less than 2.000 is placed on academic warning.

3. A low-credit student whose cumulative grade-point average is at least 1.700 but below 2.000 will be placed on academic notice. A low-credit student whose cumulative grade-point average is less than 1.700 will be allowed to continue on academic warning.

4. A student who has been on academic notice or academic warning:

If the student's semester grade-point average and cumulative grade-point average are at least 2.000, the student will be in satisfactory academic standing.

If the student's semester grade-point average is at least 2.000 but cumulative grade-point average is less than 2.000, the student will be academically suspended.

If the student's semester grade-point average is less than 2.000 but cumulative grade-point average is at least 2.000, the student will be placed on academic warning.

If the student's semester grade-point average and cumulative grade-point average are both below 2.000, the student will be academically suspended.

5. A student who has been readmitted on academic probation but who does not satisfy the requirements of probation at the end of the probationary term is academically dismissed from the University.

Appeal of Suspension

Suspension may be appealed if and only if:

- the student has attempted at least 21 but less than 35 credit hours* and has a cumulative grade-point average greater than 1.700; or
- the student has attempted at least 35 but less than 69 credit hours* and has a cumulative grade-point average greater than 1.800; or
- the student has attempted at least 69 credit hours* and has a cumulative grade-point average greater than 1.900.

*Included in course hours attempted are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with qualitative letter grades, and credits attempted with notation of Incomplete or with nonqualitative grades of P and S) and all hours of course work which have been failed with the qualitative letter grade of F. Courses which have been failed and which carry the non-qualitative symbols of U and NC are not included in the computation of course hours attempted.

If eligible for appeal, a suspended student may submit a written appeal to the Associate Provost, requesting permission to continue enrollment in an additional semester of academic warning. The written appeal must include a proposed program of full-time study for the following

semester, approved by the student's academic advisor. The student will be notified in writing of the decision of the Associate Provost. If permission to continue is granted, the program of study that must be undertaken and the minimum semester grade-point average that must be attained during the additional semester of academic warning will be detailed.

Entering freshmen and transfer students who are permitted to initiate their University studies with summer school day courses should note that credits attempted in University summer sessions are included in calculations for the fall semester. Entering students who have initiated their University studies in authorized summer school courses are not permitted to invoke the regulation concerning course repetition for the purpose of grade substitution prior to the initial evaluation of their records for retention purposes. Subsequent to initial evaluations for retention purposes, the records of all students (including probationary students) are evaluated at the end of each semester.

Students are permitted to use the January Intersession and the summer programs in an attempt to improve their academic standing, with the exception that freshmen are not permitted to use the January intersession to amend their academic standing for the spring semester.

Academic Probation

A student who has been suspended from the University is entitled to apply to the Associate Provost for readmission as a probationary student in accordance with procedures enumerated under the admission policy heading "Probationary Readmission." Students who are readmitted on probation will receive a letter from the Associate Provost which will specify the conditions of their probation, their probationary courses, and the semester average which they must achieve during their probationary semester in order to achieve satisfactory academic standing.

Probationary students are prohibited from holding student offices or running for elective office and from representing the University in athletic or other activities.

A student who achieves the required minimum semester grade-point average during his or her probation is automatically reinstated as a student in satisfactory academic standing. A student whose semester grade-point average falls below that required by no more than 0.100 may be granted an extension of the probationary period for one additional semester. Such extension of probation, if granted, will be made by the Associate Provost during the period between semesters. Students who are granted such extensions will be notified in writing prior to the beginning of classes for the following semester that they have been granted an additional semester to achieve satisfactory academic standing.

Students who fail to achieve satisfactory academic standing and are not granted extensions of their probations by the Associate Provost and students who are granted such extensions and fail to achieve satisfactory academic standing are dismissed from the University and are subsequently barred from attending both day and Continuing Studies courses.

Students readmitted on probation should not withdraw from any course unless they withdraw from the University with permission of the college dean for reasons of emergency or for medical reasons. A probationary student who withdraws from any course may thus be unable to satisfy the conditions of his or her probation and may be dismissed from the University at the end of the current semester of enrollment.

Probationary students who receive course evaluations of I (incomplete) and who fail to make-up their work prior to the beginning of the next semester are advised that they may not qualify for extension of their probation and may not register for nor attend University courses (including continuing studies courses) until such time as a final determination of their status has been made. Probationary students who have received permission of the Associate Provost to extend their make-up period should understand that such extension does not waive the requirement for a final determination of academic standing which is based upon grades for all probationary courses.

Registration and Course Enrollment Policies

All students are required to register for courses during periods which are officially designated for registration and pre-registration unless they have been authorized to make other arrangements by the dean of the college in which they are matriculated. Non-matriculated students are permitted to enroll for course loads only as specified by their conditions of admission. Except for part-time students in the Encore program, all matriculated students (including probationary students) must register for courses which comply with prescribed courses of study and must comply with the policies (below) concerning semester course loads and reduced load status.

Semester Registration

Students are required to register in person during the designated pre-registration and registration periods. Students have complied with the pre-registration requirement when they have had a schedule of lecture, recitation and laboratory work approved by their advisors and have filled in and processed the forms provided by the Registrar's office. They have satisfied the registration requirement when they have paid the required tuition and fees and have complied with the course drop and add process.

Endorsements of instructors and advisors are required for each change of enrollment card which is filed. Students who pre-register for courses for which they subsequently fail to satisfy prerequisites must initiate changes of registration during the add-drop period. Students are not enrolled in classes for which they are not properly registered.

The Office of the Registrar mails copies of individual semester schedules to students at the mailing address on file in the Registrar's Office. Students are advised that such mailing constitutes official notification from the University concerning each individual's record of course registrations. Students who believe that errors have been made in their registrations should consult with the Office of the Registrar prior to the deadline for adding courses. Students who do not check their mail and accordingly fail to correct sched-

uling errors by established deadlines may not expect to have University regulations waived for their benefit.

Course Additions

Students who wish to add a course during the first ten days of classes may do so in person at the Office of the Registrar or by using the telephone Voice Response System.

Dropped Courses

A student who wishes to drop* a course may do so in person at the Office of the Registrar or, during the first ten days of classes, by using the telephone Voice Response System.

There are only two cases for which a drop is not necessary:

1. if the course is cancelled by the University; or
2. if courses (or sections) carry no credit and will not appear on the permanent record card.

*Courses dropped during the first ten days of classes will not show on the permanent record. Courses dropped from the 11th to the 50th day of class will be assigned a grade of W and will appear on the permanent record.

Courses Cancelled by the University

Students are not required to drop courses or sections which are cancelled subsequent to pre-registration by the University. If students wish to replace a cancelled course with another, they must follow the above procedures for course additions.

Semester Course Loads

The typical course load expectation for full-time students is 15 credits. Professional curricula may specify credits in excess of this number, in which case such specifications are regarded as regular course loads.

Maximum Credit Loads

Students may enroll for course loads in excess of 15 credits but are advised that

course loads in excess of the number of credits specified by recommended courses of study may not be in their academic interests when their grade-point averages are less than 3.000.

Unless specified as part of an established course of study, course loads in excess of 15 credits are recommended for enrichment purposes only and should be taken as pass courses. In any event, a student is prohibited from registering for course loads in excess of 20 credits unless such loads are required by established University curricula or unless special permission has been granted by the dean of the college in which the student has established matriculation.

Students who are enrolled in curricula which do not require a semester course load in excess of 20 credits and who wish to obtain permission to carry such an overload must file an academic petition with the dean of the college in which they have established matriculation. Students who register for course loads in excess of 20 credits (including continuing studies courses) without the prior authorization of the dean of the college in which they have established matriculation will not receive credit for more than 20 credits per semester and the college dean shall determine which course(s) shall receive the administrative symbol of Y. Permission to carry course loads in excess of stated maxima will be denied when resources of a college or program render it necessary to establish limitations on course enrollments.

Minimum Credit Loads

Matriculating students are classified as full-time when they carry a course credit load in University day programs which is specified by their curricula. Full-time students are required to register for a minimum of 12 credits of day courses each semester, and unless subsequently granted part-time enrollment status, to remain registered for 12 credits of day courses at all times.

Part-time Enrollment

A matriculating student who desires to enroll on a part-time basis, i.e., to register for fewer than 12 credits in a given semester, must complete an Application for Part-time Enrollment (available in the Office of Academic Affairs) and submit the applica-

tion to the Office of Academic Affairs prior to the last day for adding courses in that semester. Permission, if granted, is applicable only for that specific semester and is not automatically renewed.

A student who is approved for enrollment on a part-time basis is charged by the credit hour for tuition and all applicable fees.

Students who apply for permission to enroll on a part-time basis should understand that part-time enrollment may have an impact on financial aid and on eligibility for insurance through non-University agencies. Students who enroll for fewer than six credits may be required to begin repayment of student loans. Varsity athletes and international students on I-20 permits must enroll in a minimum of 12 credits per semester and may not be part-time students.

Repeated Coursework/Course Deletions

General Policies

Course repetition is permitted only in accordance with the policies cited below, the provisions of which are applicable only to courses taken at the University of Massachusetts Lowell and consequently do not apply to off-campus courses.

A course substitution is not permitted under the provisions of this regulation unless a course has been dropped as a University offering and an alternate course has been authorized as a suitable substitution by the chairperson of the department which offered the course. Once a student has reached the credit limitations which are cited below, no further courses may be replaced for the purpose of grade substitution, nor may a student who has used the maximum number of course repetitions for the purpose of grade substitution petition to revoke one or more of these substitutions in order to permit course repetition and grade substitution in an additional course or courses.

Grade Substitution/Deletion Rule

Students who have entered the University as freshmen or transferred to the University with less than 60 semester credits are permitted a maximum of fifteen semester credits of course repetitions/deletions for the purpose of remov-

ing grades of CD or less for previously completed courses in the computation of their cumulative grade-point averages. Transfer students who have entered the University with 60 or more credits are permitted a maximum of seven semester credits of course repetitions for this purpose. The number of actual course repetitions which are permitted for any student depends upon the number of credits which are allocated to those courses which he or she wishes to repeat.

Administrative Requirements

When students register for courses which they wish to repeat, they must notify the Office of the Registrar at the time of registration.

Repetition of Passed Courses

Except for courses of a professional nature which regulations of a college may designate as being non-repeatable, students may repeat a course previously passed with a grade of CD or D within the provisions of the grade substitution rule cited above. When a previously passed course has been repeated within the provisions of this regulation, the cumulative grade-point average is appropriately corrected for the semester in which the course is repeated. If the grade for the repeated course is lower than the original grade in the course, the lower grade may be deleted under the provisions of the grade deletion rule (see above). Credit is never granted twice for a course which has been taken and passed and subsequently taken again and passed for the second time.

Repetition of Failed Courses

Except for courses of a professional nature which regulations of a college may designate as non-repeatable, students may substitute passing grades for repeated failed courses in the computation of cumulative grade-point averages. Except for non-repeatable courses, students must repeat all required courses which they have failed. Courses in which F grades have been received must be repeated and passed before students may take courses for which those failed are prerequisites.

A course which is failed but is not required for a student's program need not be repeated, but other course work must be taken when a student's total degree program will fall short of the specified credit hours for degree requirements. Unless a failed course is repeated within the deadlines for grade substitution, cited above, both the original failing grade and the repeated course grade are counted in computing grade-point averages. Although the provisions of the grade substitution rule and the requirements for maintaining satisfactory academic standing may indirectly limit the number of failed courses which a student may repeat, no formal limitation is placed upon the number of failed courses which may be repeated.

Repetition of Transferred Courses

When competence is demonstrably inadequate, a student who has been granted transfer credit (and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite) may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred.

Permission to repeat a transferred course is granted by filing an academic petition form with the dean of the college. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

University of Massachusetts Lowell Division of Continuing Studies

Subject to University residency requirements and college regulations, the following categories of day students may be permitted to register for continuing studies, January intersession, and summer school courses at the University of Massachusetts Lowell and to have such courses credited to baccalaureate day programs:

1. individuals who have been admitted to day colleges for full-time baccalaureate study;

2. individuals in satisfactory academic standing who are currently matriculating in day colleges of the University;* and
3. previously matriculated students in day colleges who withdrew from the University while in satisfactory academic standing, and who have been readmitted to programs in which they were previously enrolled.

Individuals are warned that departments reserve the right to deny baccalaureate credit for University of Massachusetts Lowell continuing studies, January intersession, and summer school courses which have been taken in violation of University residency requirements, curriculum requirements of their baccalaureate day programs, and/or special college regulations. Students who have been suspended or dismissed from day programs of the University are prohibited from enrolling in any program of the University. Students who combine University day courses with continuing education courses during the regular academic year are subject to all restrictions concerning semester course loads (cf. "Registration and Course Enrollment Policies").

*Students on academic warning are permitted to register for continuing studies, January intersession, and summer school courses; students who have been suspended are prohibited from enrolling in any course offered by the University.

Off-Campus Study

Matriculating students in satisfactory academic standing may be permitted to apply off-campus courses to their degree programs when they comply with established procedures. Students wishing to apply credits earned off-campus must obtain approval prior to off-campus enrollment, through an "Authorization of Off-Campus Courses" form available in the Office of the Registrar's Office.

Off-campus courses may be taken in regionally-accredited institutions only, and ordinarily should be taken at baccalaureate colleges or universities. Permission to pursue off-campus courses in regionally-accredited associate degree institutions may be granted to students with less than 60 earned credits and only for courses which are to be presented for lower-divi-

sion requirements of University of Massachusetts Lowell curricula. All off-campus courses must be taken under the regular grading system and may not be taken on a pass-no credit (pass/fail) basis.

University Restrictions Concerning Off-Campus Study

Students are not permitted to pursue off-campus courses until an initial evaluation of their academic progress at the University has been made. Students who have transferred to the University with 60 or more semester credits, or who have been admitted from another institution with a baccalaureate degree to pursue a second bachelor's degree, are not permitted to pursue off-campus studies. Students who combine University courses with off-campus courses during the regular academic year are subject to University restrictions on semester course loads.

Full-Time Off-Campus Study

Off-campus courses may be authorized on a full-time basis for those students who have completed (or who will complete prior to graduation) three years of full-time study at Lowell (earning not less than 90 semester credits) and who wish to pursue a year abroad or who wish to complete a year as visiting students at another baccalaureate institution while completing a Lowell degree. Prior to departure, students planning to undertake full-time off-campus study should present to the dean of the college of their enrollment an academic petition which seeks authorization of the proposed course of study. Following a review of the petition and of the proposed course of study, the dean will endorse the petition, informing both the student and the Registrar of the acceptability of the course of study to the student's degree program.

Since some colleges of the University do not permit full-time off-campus study, students should ascertain the policy of their college before pursuing arrangements with other institutions. Students who wish to pursue full-time off-campus studies are advised that they must satisfy academic and residency requirements concerning courses in the major field

(cf. "General Degree Requirements:

Residency Requirements").

Calendar Deadline Changes of Course Enrollment Status

The last day for students to add a course, to change sections within a course, and to change enrollment status from audit to credit or from credit to audit and from pass-no credit to letter grade or from letter grade to pass-no credit is the tenth class day of the semester. The last day for dropping a course without penalty (with a course notation of W) is the 50th class day of the semester. Students must file all change of status forms in the Office of the Registrar by the published calendar deadlines.

Advisory System

Academic advising is performed by full-time faculty members. Students who have been accepted by departments for academic or professional majors receive their academic advising from a member of their major department or, in the case of students pursuing interdisciplinary majors, from members of an appropriate interdisciplinary committee. Students who have not made declarations of their major fields are assigned faculty advisors from within the college in which they are enrolled. Entering students are advised during the period of initial registration by a cadre of faculty advisors and are subsequently assigned advisors on the basis of their declarations of major subject. If an advisor has not been assigned by the beginning of the advisory period of the student's second registration, the student should immediately reveal this fact to the dean of the college in which he or she is enrolled.

The faculty advisor assists the student in developing a program of courses prior to semester registration and in formulating a program of studies leading to a degree and generally provides whatever guidance and assistance a student may require in making appropriate academic decisions throughout his or her period of baccalaureate studies. However, each student is personally responsible for complying with all rules and regulations of the University and is solely responsible for completing all degree requirements.

The advisor maintains records showing the program of study for each of his or her assigned students, including subjects taken, grades earned, and changes of contemplated programs. For the purpose of providing appropriate academic advising, each faculty member is available for consultation throughout the semester. Faculty members maintain three office hours per week on three different days during periods in which classes are scheduled and maintain a minimum of five office hours per week during periods of student advisement for course registration. Schedules of office hours are published by departments for their members and the schedule of faculty office hours for each faculty member is posted in such a manner as may be observed easily by students.

Course Requirements

Within the policies listed below, faculty members are permitted to establish their examination and course requirements.

Course Examination Policies

Final examinations are required for all undergraduate courses of the University unless exemptions have been granted by the department chairperson and the dean of the college. Exemption requests must be made by the end of the first month of the semester. Final examinations may not be given at a place or time other than those which have been specified by the Registrar.

There shall be no final examinations other than those administered during the final examination period. No hour examination shall be administered during the last five academic days of the semester unless exemption has been allowed by the college dean. Final take-home examinations may be submitted to instructors during the final examination period only. Take home examinations may be submitted only on the day and at the time which the Registrar has scheduled the final examination for the course in question.

Instructor Course Requirements

By the end of the first full week of classes, instructors must distribute a written statement of requirements, prerequisites and corequisites for each course and section

to all students and to the department chairperson. This statement must include a specification of the number and types of course evaluations to be employed throughout the semester (including approximate date and nature of the first evaluation), special requirements for completing assignments and taking examinations, and a definition of course attendance policy. By the end of the seventh week of classes, each faculty member and course coordinator must provide the department chairperson with the date, time, and nature of the first evaluation in the course.

Normally, a minimum of three evaluations of student progress (written or oral examinations, written reports, recitations, laboratory techniques and reports, jury or performance evaluations) should be made in each course, at least one evaluation being required during each half semester. Upon the request of a student, an instructor is required to provide a statement of the student's course progress. Prior to the last date for withdrawing from courses, students who are in danger of receiving D or F grades either shall be so notified by the instructor or shall be in possession of such course evaluations as will permit such students to reasonably infer their course progress and academic jeopardy.

Student Complaints Arising from Grades and Grading Policy of a Faculty Member

Faculty are expected, as a matter of right and professional standards, to recompute any grade in which a computational error is alleged or suspected, provided that the student challenges the grade before the deadline established by the calendar for filing final course grades and grade changes. However, no challenge or appeal shall be allowed in the matter of grades and grading policies except when a faculty member is alleged to have violated University, college, or department academic regulations and policies, or the faculty member's own grading policy, the latter to be determined from the published course requirements for the course or section in question.

Appeals of grades or grading policies arising from alleged violations of established or published policies will follow proce-

dures cited below under the heading "Complaints Concerning Classroom Matters." The terms "grade" and "grading policy" refer 1) to all grades awarded, 2) to the computation of grades for examinations (including final examinations), tests, quizzes, papers, essays, laboratory reports, practicum experiences, and any other kind of academic activity for which a grade of any kind is awarded, and 3) the final course grade which is submitted to the Office of the Registrar.

Complaints Concerning Classroom Matters Exclusive of Grades and Grading Policy

Students confronting classroom problems which are a source of legitimate concern are entitled to have their complaints heard and resolved according to the procedures specified below.

Classroom problems may include, but are not limited to, the following examples (but note that questions concerning grades and grading policies are reserved to the process specified above):

1. faculty failure to observe University policy and/or regulations, such as violating the regulation against scheduling examinations during the last week of the semester;
2. changing class schedules without the permission of the department chairperson and the college dean, or rescheduling of final examinations (including setting a due date for take-home examinations) to a time and place other than that established by the Office of the Registrar;
3. terminating semester classes prior to the date specified by the University calendar;
4. failing to fulfill instructional obligations (such as unjustified cancellation of classes, frequent absenteeism, and lateness);
5. failing to provide and distribute a written statement of course requirements which is mandated for all instructors;
6. failing to adhere to the written statement of course requirements; and
7. failing to post office hours or to maintain such hours.

Students normally should seek to resolve problems by discussion with the faculty member. If this is not feasible (e.g., for reasons of intimidation or threat) or if,

after discussion, the matter cannot be resolved, the student shall inform the faculty member in writing that he or she will initiate a formal complaint. This complaint shall be in writing and shall be addressed jointly to the chairperson of the department and the dean of the college in which the alleged problem and/or violation occurred.

After discussing the problem with the student and the faculty member, the chairperson and the dean will make a determination. Should the subject of a formal complaint be a department chairperson, the review and determination will be made by the dean and the chairperson of another department. Copies of the complaint, together with the written decision of the chairperson and the dean, shall be sent to the student, the faculty member, the Provost and Vice Chancellor for Academic Affairs, and the President of the MSP.

Formal complaints about classroom problems shall be initiated before the last day of the semester examinations in the semester during which the violation is alleged to have occurred. The determination of the chairperson and the dean shall be made within ten working days following receipt of the student complaint and, if unchallenged by the MSP, shall be final.

Discrimination and/or Harassment

Any student who believes that he or she has been discriminated against on the basis of sex, race, color, national origin, creed, religion, age, handicap, or veteran's status or that the University in any of its aspects is operating in a manner which adversely affects female, minority or handicapped students or veterans should contact the Affirmative Action Officer/Coordinator for Title IX and Handicapped Affairs immediately. Alleged discrimination or harassment which does not come under the purview of the Affirmative Action Office should be pursued in accordance with the procedures outlined above for the resolution of classroom problems.

Attendance Policies

Although the University does not require class attendance as a matter of institutional policy, course instructors have the

option of establishing required attendance in their courses and of specifying penalties for student violations of such attendance requirements. Colleges also have this option and sometimes have adopted attendance policies for introductory courses and specialized learning situations.

Instructor Attendance Policies

At the beginning of each course, the instructor will inform students of any specific attendance regulations which apply.

Attendance Requirements of the Veterans Administration

In compliance with the requirements of the Veterans Administration (VA), all recipients of Veterans benefits, including eligible children of veterans, must certify their attendance at the University under penalty of perjury by the following procedures:

On the first Monday of each month, or on the following day if Monday is a holiday, each recipient of VA benefits is required to register his or her attendance at the office of the dean of his or her college. This procedure is also repeated on the third Monday, or on the following day if Monday is a holiday. All changes in status of the VA recipient also must be reported.

Failure to register attendance will be reported immediately by the college dean to the Registrar, who will attempt to contact the student personally. If no satisfactory response is elicited for failure to register within one week of the reporting date, or if the Registrar is unable to reach the student at his or her official residence, the Registrar will inform the Veterans Administration that the University is unable to verify this student's attendance.

Absence of Students for Religious Beliefs

Chapter 375, Acts of 1975 of the Commonwealth of Massachusetts requires recognition of student religious beliefs as noted.

"Any student...who is unable, because of his religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination or

study or work requirements, and shall be provided with an opportunity to make up such examination, study, or work requirement which he may have missed because of such absence on a particular day; provided, however, that such make up examination or work shall not create an unreasonable burden upon such school. No fees of any kind shall be charged by the institution for making available to the said student such opportunity. No adverse or prejudicial effects shall result to any student because of his availing himself of the provisions of this section."

Students should inform the course Instructor in writing of the day(s) they will be absent. This should be done as early as possible in the semester and always prior to the day(s) the student will be absent for religious reasons.

Right of Access to Student Records

The Family Rights and Privacy Act of 1974 grants any student currently in attendance, or to any former student, the right of access to inspect or review his or her educational files, records, or data. Students who wish to inspect their records must file a Right of Access form with the office or department in which the desired record is kept. Right of Access forms are available in the Office of Student Services or the Registrar's Office. Within ten days of receipt of the Right of Access form, the office or department will notify the student as to the date, time, and location when the desired record will be available for inspection.

The University maintains the following general records on students:

Admission File

Admissions Office

Dugan Hall, South Campus

Permanent Academic Records

Office of the Registrar

Southwick Hall, North Campus

Financial Aid Records

Financial Aid Office

McGauvran Student Union Building

South Campus

Health Records

Health Services Office

McGauvran, South Campus

Account and Payment Records

Business Office

Dugan Hall, South Campus

The file of each student must contain a record of all non-University affiliated individuals or organizations requesting access to it, plus statements which specify the legitimate educational purposes for which access was requested. The record of access may be released only to University personnel or to state or federal officials as a means of auditing the reporting of access to student records.

Information or records concerning individual students may not be released to any individual or agency without written permission of the student. Any request for such information received without such written notice will not be honored and will be returned with a request for a written release by the student.

Educational records may be released without permission to the following individuals or agencies under the following specific conditions:

1. personnel of the University, i.e., faculty, administrators, or staff for legitimate educational purposes only;
2. officials of other institutions in which the student is enrolled, provided that the student is notified of the release;
3. federal or state officials in connection with the audit and evaluation of programs funded by the federal or state governments or in connection with the enforcement of legal requirements which relate to such programs or in connection with the student's application for or receipt of financial aid;
4. state and local officials pursuant to any state statute adopted prior to November 19, 1974;
5. organizations conducting studies for the purpose of developing predictive tests, administering student aid programs, and improving instruction;
6. accrediting organizations in order to carry out their accrediting functions;

7. parents who claim the student as a dependent on their IRS statement; and

8. when necessary in an emergency, to protect the health, safety or welfare of the student or others, to persons who are in a position to deal with the emergency.

The following data is considered informational in nature and may be released, without permission of the student, at the discretion of the University: name, city/town of residence, University mail box #, date of birth, previous educational institution(s) attended, major field of study, dates of attendance, awards & honors received, degrees conferred, past and present participation in officially recognized sports & activities and height & weight of athletic team members.

Any student who believes that his or her records are inaccurate or misleading may request a hearing with the Dean of Students to discuss the contents of such records. Additional information on procedures or policies relating to University compliance with the Family Rights and Privacy Act can be obtained from the Office of Student Services or the Registrar's Office.

Course Descriptions

Each course offering is designated by a two-digit prefix and a three-digit course number. The two digit college prefix identifies a college department and/or special area. The three-digit course number identifies the course level.

Course Prefixes

Each college department and/or special subject area has been assigned an identifying two digit number (e.g., 92.131) within the numerical ranges specified as follows:

Education	01-09
Engineering	10-28
Health Profession	30-39
Liberal Arts	40-59
Management	60-69
Fine Arts	70-79
Science and Math	80-99

Course Numbers

A course number consists of three digits which follow the course/department prefix (for example, 92.131). Courses numbered 001-099 are pre-freshman and special undergraduate courses and do not carry baccalaureate degree credit. Those numbers 100-299 are lower division undergraduate courses and those numbered 300-499 are upper division undergraduate courses. The 400 level courses are generally limited to juniors and seniors majoring in a field but are open, with permission, to other advanced undergraduates and to graduate students.

Directed studies courses and practicum experience courses are generally limited by departmental policy to students majoring in the area in which such courses are offered

Courses numbered 500-599 are graduate courses which are open to upper division undergraduates with the consent of instructors and chairpersons. Courses numbered 600-699 are graduate courses which are open only to graduate students. Courses numbered 700-799 designate graduate research projects and graduate theses.

Semester, Class, and Credit Designations

Courses which are offered during the fall semester are designated by the Roman numeral I; spring semester courses are designated by the Roman numeral II; and courses which are offered during both fall and spring semesters are designated by the Roman numerals I, II. Courses which are not prescheduled for specific semesters carry no Roman numerical designation.

In the event that a course is offered during the first half of a semester, the Roman numeral is followed by the letter A. A course which is offered during the second half of a semester is followed by the letter B.

Arabic numbers enclosed in parentheses indicate the number of hours of lecture/recitation and of laboratory/applied activity. The Arabic number following the numbers in parentheses is a designation of course credit. For example the designation IB(6,0)3

means that a course is offered during the second half of the fall semester, requires six hours of lecture/recitation per week and carries three semester credits.

Similarly, the designation II(2,6)4 means that a course is offered during the spring semester, requires two hours of lecture/recitation per week and six hours of laboratory/applied activity per week and carries four semester credits.

Course Restrictions

Special course prerequisites, corequisites, and enrollment restrictions are indicated at the end of the course description. A course which is listed as a prerequisite must have been completed and passed prior to taking the course for which the prerequisite is specified.

Subject to college or department policy to the contrary, an exception to this limitation may be granted by the designated instructor only. A course which is listed as a corequisite must be taken during the same semester as the course for which the corequisite is specified.

Courses which carry such notations as "open for majors only" and "sophomore status required" are restricted to the specified students. Courses which carry the notation "permission of instructor" require instructor approval in order to enroll.

Courses at the 100-300 levels which do not carry prerequisite, corequisite, and enrollment restrictions are open for election by all students unless general restrictions have been listed under the department or course area heading, or unless policy of the college or department in which the student is matriculated prohibits such registration.

Honorary and Professional Societies

Alpha Nu Sigma (Nuclear Science and Engineering)

American Chemical Society

American Society for Chemical Engineers

American Society for Civil Engineers

American Society for Mechanical Engineers

American Meteorological Society

American Nuclear Society

Association of Pulp and Paper Industry

Eta Kappa Nu (Electrical Engineering)

Institute of Electrical and Electronics Engineers

Music Educators National Conference

Pi Lambda Theta(Education)

Pi Mu Epsilon (Mathematics)

Pi Tau Sigma (Mechanical Engineering)

Radiological Health Physics Society

Sigma Gamma Epsilon (Earth Sciences Honor Society)

Sigma Theta Tau, Eta Omega Chapter (Nursing)

Sigma Xi

Society for Physics Students

Society for Plastics Engineers

Society for the Advancement of Management

Tau Beta Pi (Engineering Honor Society)



Aerospace Studies

The program is designed to qualify for commissions those men and women who desire to serve in the United States Air Force and to provide an education which will develop skills and attitudes of vital importance to professional Air Force officers. The Air Force

ROTC program is divided into two phases: 1) the General Military Course (GMC), and 2) the Professional Officer Course (POC).

Students may elect to enroll in either the

four-year or the two-year AFROTC program. Students electing the four-year program will take the General Military Course during their freshman and sophomore years which consists of one hour of class and two hours of leadership laboratory per week. Students in the four-year program attend four weeks of field training during the summer between their sophomore and junior years. As members of the program, they are eligible to compete for AFROTC scholarships. For acceptance into the Professional Officer Course, students enrolled in the four-year program must meet physical standards, pass an officer qualification test, possess an acceptable academic record, and meet Air Force commissioning criteria. The POC consists of three hours of class and two hours of leadership laboratory per week.

To qualify for enrollment in the two-year program, students must have two academic years remaining at either the graduate or undergraduate level or combination of these levels. They must meet physical standards, pass an officer qualification test, possess an acceptable academic record, and meet Air Force commissioning criteria. They must also successfully complete a six-week field training course before they can be accepted into the POC.

Aerospace Studies

Lt. Col. Elizabeth A. Lassiter, Chairperson
 Professor: Elizabeth A. Lassiter
 Assistant Professors: Sean A. Harrington,
 Eileen M. LaBrecque

University Policies Concerning Aerospace Courses

Both General Military Courses (AS 100 and AS 200) and Professional Officer Courses (AS 300 and AS 400) in Aerospace Studies may be used as undesignated or unrestricted elective courses in a student's baccalaureate program. Grades for all AFROTC courses are applicable to the determination of grade-point averages. Students should consult the regulations of the college in which they are matriculating concerning the number of AFROTC courses which may be included as part of their programs of study. In the event that such elective courses are insufficient to accommodate all the AFROTC courses, students wishing to pursue the AFROTC program will be required to fulfill program requirements on an overload basis. Consequently, AFROTC credit toward graduation requirements will vary from six (minimum to meet AFROTC/University of Massachusetts Lowell contract requirements) to sixteen credits dependent on the student's particular college and degree program. Some colleges allow AFROTC courses to be substituted for technical or general electives.

AFROTC Requirements

Uniforms, equipment, and textbooks which are required for AFROTC will be supplied. Students in the POC or on scholarship receive a monthly subsistence allowance of \$150.00. Competitive scholarships are available for academically qualified cadets in the program. Students who successfully complete the POC are commissioned as second lieutenants in the United States Air Force and serve on active duty in the Air Force.

Field training

AFROTC field training is offered during the summer months at selected Air Force

bases throughout the United States. Students in the four-year program participate in four weeks of field training, usually between their sophomore and junior years. Students applying for entry into the two-year program must successfully complete six weeks for field training prior to enrollment in the Professional Officer Courses.

The major areas of study in the four-week field training program include junior officer training, aircraft and aircrew orientation, career orientation, survival training, base functions and Air Force environment, and physical training.

The major areas of study included in the six-week field training program are essentially the same as those conducted at four-week field training and in the General Military Course including leadership laboratory.

Leadership Laboratory

Leadership Laboratory is taken an average of two hours per week throughout the student's period of enrollment in AFROTC. Instruction is conducted within the framework of an organized cadet corps with a progression of experiences designed to develop each student's leadership potential. Leadership laboratory involves a study of Air Force customs and courtesies; drill and ceremonies; career opportunities in the Air Force; and the life and work of an Air Force junior officer. Students develop their leadership potential in a practical, supervised laboratory, which typically includes field trips to Air Force installations throughout the United States.

The Department of Aerospace Studies is a unit of the Office of Academic Affairs and conducts the Air Force ROTC program. All ROTC courses, with the exception of leadership laboratory may be taken by any university student for credit without actually joining the AFROTC program. Call (978) 934-2252 or stop by Southwick 328, for additional information.

Aerospace Studies (Course Prefix: 29)

29.101 The Air Force Today - Part I
 Topics relating to the Air Force and defense. Structure and missions of Air Force organizations; officership and pro-

fessionalism; and includes an introduction to communicative skills. 1 cr.

29.102 The Air Force Today - Part II
 Completion of the Material described in 29.101. 1 cr.

29.201 The Development of Air Power - part I

Factors contributing to the development of air power from its earliest beginnings through two World Wars; the evolution of air power concepts and doctrine; and an assessment of communicative skills (speaking and writing). 1 cr.

29.202 The Development of Air Power - Part II
 Completion of the Material described in 29.201. 1 cr.

29.301 Air Force Management and Leadership - Part I

Emphasizing the individual as a leader/manager in a Fortune 500/Air Force setting. The individual motivational and behavioral processes, leadership, communication, and group dynamics are covered to provide a foundation for the development of the professional skills needed by Air Force officers and middle managers. The basic managerial processes involving decision-making, utilization of analytic aids in planning, organizing, and controlling in a changing environment are emphasized as necessary professional concepts. Organizational and personal values, management of forces in change, organizational power, politics, and managerial strategy and tactics are discussed within the context of the military organization. Actual Air Force and corporate case studies are used to enhance the learning and communication processes. 3 cr.

29.302 Air Force Management and Leadership - Part II
 Continuation of the material described in 29.301. 3 cr.

29.401 National Security Forces in Contemporary American Society- Part I

An examination of the needs for national security; an analysis of the evolution and formulation of the American defense policy and strategy; aerospace doctrine; an examination of the methods for managing

conflict; and an overview of alliances and regional security, arms control, and terrorism. Special topics of interest focus on the military as a profession, officership, the military justice system, and current issues affecting military professionals. Continued emphasis is given to the refinement of communicative skills. 3 cr.

29.402 National Security Forces in Contemporary American Society - Part II

Continuation of the material described in 29.401. 3 cr.

Faculty of Aerospace Studies

Elizabeth A. Lassiter, Lieutenant Colonel, USAF, Professor of Aerospace Studies; B.S., Troy State University; M.S., Golden Gate University.

Sean A. Harrington, Captain, USAF, Assistant Professor of Aerospace Studies; B.A. Southern Connecticut State University; M.P.A., Webster University

Eileen M. LaBrecque, 1st Lieutenant, USAF, Assistant Professor of Aerospace Studies; B.A., UMass Lowell; M.B.A., UMass Lowell

The College of Arts and Sciences is the University's great marketplace of knowledge and ideas. It offers students the opportunity to learn about the collective achievements of humanity and to acquire the skills and attitudes that will make them successful in life and work.

In the College of Arts and Sciences, each student specializes in a field of study. In addition to this specialized focus, students are encouraged to

make connections across disciplines and to integrate knowledge from different courses and subjects.

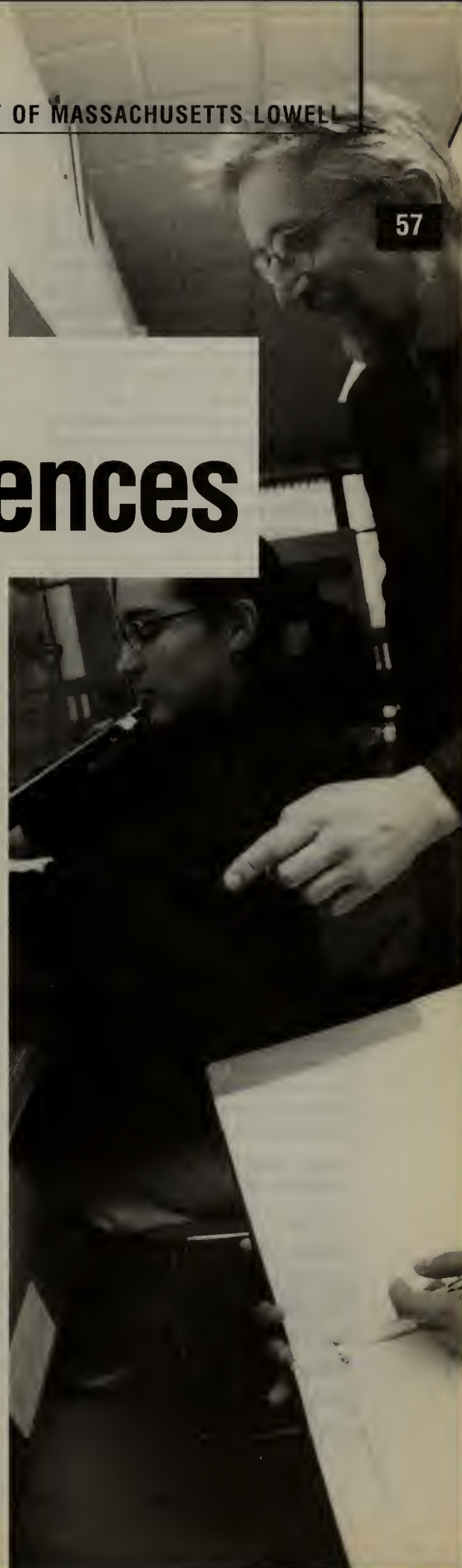
The College of Arts and Sciences offers the Bachelor of Arts, Bachelor of Fine Arts, Bachelor of Liberal Arts, Bachelor of Music, and Bachelor of Science degrees in twenty major fields, with a number of options and minors. An undergraduate degree in Arts and Sciences offers students a broad foundation of general education with preparation for a career or advanced study at the graduate level. The College also offers Master's and Doctoral degree programs in conjunction with the Graduate School. For information about graduate programs, consult the Graduate Catalogue.

The greatest benefit of a college education is not the specific materials learned in a course of study but rather the ability to think, to analyze, and to adapt to changing times. Most people will change careers at least once during their work life, and many of the careers that exist today that require a college education did not exist when their practitioners were in college. Thus, to be successful in the job market and to develop a satisfying and rewarding career, a student must develop a broad base of knowledge, learn to think critically, and adapt to a changing economy. Students seeking that breadth and diversity are well-served by the curriculum offered through the University of Massachusetts Lowell's College of Arts and Sciences.

Nancy Kleniewski, Dean of Fine Arts, Humanities, and Social Sciences

Robert H. Tamarin, Dean of Sciences

College of Arts & Sciences



Mission of the College

The mission of the College of Arts and Sciences is to foster critical and creative thinking for future solutions to environmental, economic, and human problems while helping students to develop the capacity to respond to a changing world. The faculty emphasize quality instruction, research, and creative activity as well as service to the community. Through activities such as applied research and student internships, in which students and faculty use their expertise in the community, the College serves the economic and social needs of the Merrimack Valley region.

College Organization and Governance

The College of Arts and Sciences consists of two divisions: the Division of Sciences and the Division of Fine Arts, Humanities, and Social Sciences. The Division of Sciences contains six departments and the Division of Fine Arts, Humanities, and Social Sciences contains twelve departments. Two deans, one for each division, collaborate in directing the College.

The Dean's Office of the Division of Sciences is located in Olney Hall, Room 524; the telephone number is (978) 934-3840. The Dean's Office of the Division of Fine Arts, Humanities, and Social Sciences is located in Durgin Hall, Room 106; the telephone number is (978) 934-3832.

College Facilities

Departmental Facilities

The faculty offices, including those of department chairpersons, are housed in the following locations:

On the North Campus:

Biological Sciences	Olsen Hall
Chemistry	Olney Hall
Computer Science	Olsen Hall
Environmental, Earth, and Atmospheric Sciences	Olney Hall
Economics	Falmouth Hall
Mathematics	Olsen Hall
Philosophy	Olney Hall
Physics	Olney Hall

On the South Campus:

Art	McGauvran Hall
Criminal Justice	Mahoney Hall
English	O'Leary Library
History	Coburn Hall
Languages	Coburn Hall
Music	Durgin Hall
Political Science	Coburn Hall
Psychology	Mahoney Hall
Regional Economic and Social Development	O'Leary Library
Sociology	Coburn Hall

Special Facilities

Special facilities of the College include an art gallery, two concert halls, a theater, experimental laboratories, computer labs, a sound recording technology studio, and a graphics design laboratory. Among other facilities, the College also houses science laboratories, computer laboratories, undergraduate and graduate research facilities, a greenhouse, a nuclear reactor, a linear accelerator, music practice rooms, and art studios.

Center for Women in Engineering and Science

The Center for Women in Engineering and Science provides a supportive and inclusive environment for women pursuing careers in engineering and science. It offers information about pathways to resources and services available on campus as well as in government and the private sector. The Center also provides opportunities to contact industry and to help prepare women for entry into academic and industrial careers. The Center creates an environment for women students to support each other and to network among themselves.

Honorary and Professional Societies

Several departments host chapters of national honorary societies in their disciplines. These honoraries encourage and acknowledge high achievement by students. Honorary or professional societies include:

Academy of Criminal Justice Sciences
Alpha Kappa Delta (Sociology)
Association for Computing Machinery (Computer Science)
American Chemical Society
American Meteorological Society
Gamma Kappa Alpha (National Italian Honor Society)
Optical Society of America (Physics)
Pi Mu Epsilon (Mathematics)
Psi Chi (Psychology)
Radiological Health Physics Society
Sigma Delta Phi (National Spanish Honor Society)
Sigma Gamma Epsilon (Earth Sciences Honor Society)
Sigma Tau Delta (English)
Sigma Xi

Programs in the Fine Arts

The College offers programs in art and music to prepare students for careers as professional artists and musicians as well as in preparation for graduate studies, including graduate studies in music education. (For more information about the graduate programs, consult the Graduate Catalogue.) Undergraduate students may choose one of two professional degrees: the Bachelor of Fine Arts or the Bachelor of Music. The Bachelor of Fine Arts is offered by the Art Department (McGauvran Hall) and the Bachelor of Music is offered by the Department of Music (Durgin Hall).

All degree programs in the fine arts are approved by their national accrediting agencies. The University of Massachusetts Lowell is an associate member of the National Association of Schools of Art and Design and a full member of the National Association of Schools of Music.

Bachelor of Fine Arts Degree

Programs leading to the Bachelor of Fine Arts degree offer students the opportunity to prepare for careers in fine arts, commercial art, gallery work, graphic design, and photography. Students learn both the technical requirements to create art and

the aesthetic understanding to appreciate and analyze works of art.

The University has recently expanded and renovated the art studios, including the installation of a contemporary graphics design lab. In addition, the Art Department maintains two galleries. The University Gallery hosts shows by professional artists whereas the Dugan Gallery displays works by students.

Within the Bachelor of Fine Arts degree program, students may choose one of two program options:

Fine Arts

Graphic Design

Courses for both of these options are described under the Art Department listing below.

Bachelor of Music Degree

The Bachelor of Music degree offers students the opportunity to prepare for careers in performance, teaching, recording, and music management. The degree program offers four areas of specialization:

Music Performance

Music Business

Music Teaching Preparation

Sound Recording Technology

All students in the Bachelor of Music program are performing musicians, studying either voice or their chosen instrument. In addition, students choose an emphasis for career preparation. The emphasis in Performance provides opportunities for individual performance, research, and creativity to students who desire careers as professional musicians. The emphasis in Music Business combines performance with management courses. The emphasis in Sound Recording Technology combines performance with recording, engineering and computer courses. The emphasis in Music Teaching Preparation is designed to lead to a Master's of Music and certification to teach music in the public schools. Programs combining two areas of specialization, e.g., music teaching/performance, are also available. A student desiring to pursue such a combined course of study must satisfy the requirements in both areas and should plan to spend one or

more semesters in residence beyond the normal eight semesters of full-time study required for the successful completion of a program with a single area of specialization.

College Requirements for Fine Arts Students

Undergraduates in fine arts programs must comply with the University General Education requirements, must conform to the requirements of the College which govern degrees and major studies for such degrees, and must earn at least a 2.000 average in their major concentrations of specialization by the end of the senior year. Additional requirements are specified for retention in specific degree programs.

Students who have failed to achieve at least a 2.000 average in their major concentrations or other specific, stated retention standards of their degree specialization by the end of the junior year and have not made satisfactory progress toward their degrees may be placed on probationary status in the College, be disenrolled from the College, or dismissed from the University for inadequate scholarship.

Language Proficiency

Vocal performance majors are required to complete two consecutive semesters of the same foreign language, plus 75.261 Diction for the Singer I (English and German), and 75.262 Diction for the Singer II (Italian and French). Students who anticipate graduate work in such areas as music history and literature are strongly encouraged to develop proficiency during their undergraduate enrollment.

Declaration of Major

Music majors are accepted into their intended majors conditionally. They must apply officially to their program of choice. See specific major for requirements and deadlines. Students wishing to transfer to Bachelor of Music programs are required to demonstrate their vocal or instrumental ability during an audition before the music faculty and are required to complete placement testing in music theory.

Programs in the Humanities and Social Sciences

The humanities and social sciences departments offer undergraduate programs leading to the degree of Bachelor of Arts, Bachelor of Science, and Bachelor of Liberal Arts.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree provide a broad, comprehensive education with many options for developing major and minor programs. All Bachelor of Arts degree programs require completion of a major within the College in which the student is a degree candidate and (except as specified by policies concerning second majors) a minimum of 75 credits outside the major field. Following is a list of major fields in which the Bachelor of Arts degree is offered in the Humanities and Social Sciences.

American Studies

Economics

English

History

Modern Languages

French Option

Spanish Option

Philosophy

Communications and Critical Thinking Option

Political Science

Psychology

Sociology

Language Proficiency Requirement

Students enrolled in Bachelor of Arts programs in the social sciences and humanities are required to demonstrate intermediate level proficiency in a foreign language. Students who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools should consult policies noted under the heading "Academic Policies: Language Requirement" for a listing of avenues by which certification of language proficiency may be pursued.

Bachelor of Science Degree

The Bachelor of Science degree provides students with specialized training. All Bachelor of Science degree programs require completion of a major within the College and a minimum of 50 credits outside the major field. The only major field in which the B.S. degree is currently offered in the Humanities and Social Sciences is Criminal Justice.

Bachelor of Liberal Arts Degree

The Bachelor of Liberal Arts is a baccalaureate degree program offered only to fine arts, humanities, and social science students in the College of Arts and Sciences. The essence of the BLA degree is that the student takes two disciplinary concentrations of 8 to 10 courses each. The degree offers students curricular flexibility and a broad background in the humanities and social sciences. Specific degree requirements are:

1. a total of 48 to 60 credit hours in the Humanities and Social Sciences, distributed as follows: Two concentrations of 8 to 10 courses (24-30 credit hours) each, with at least half at or above the 300 level;
2. under ordinary circumstance a minor will not be permitted;
3. students may choose to fulfill either a foreign language or a computer skills requirement; and
4. in the junior year, Essay Writing for Non-Majors is required.

The following concentrations have been approved for the Bachelor of Liberal Arts Degree:

Art History
Comparative Arts
Economics
Gender Studies
History
Languages
Legal Studies
Philosophy
Political Science
Psychology
Sociology
Theater Arts

College Requirements for Humanities and Social Science Students

In order to qualify for a baccalaureate degree offered by the College of Arts and Sciences, each undergraduate in the social sciences and humanities must comply with the University general education requirements, must conform to the rules of the College that govern degrees and major studies for such degrees, and must earn a 2.200 average in his or her major area(s) of concentration by the end of the senior year. Students who have failed to achieve a 2.000 average in their major concentration(s) by the end of the junior year (typically 27 hours in the major of 89 hours undertaken by the end of the junior year) have not made satisfactory progress toward their degrees, and upon the recommendation of appropriate departmental committees and the concurrence of the Dean such students may be placed on probationary status within the College or dismissed from the University for inadequate scholarship.

Programs in the Sciences

The science and mathematics departments of the College of Arts and Sciences offer undergraduate programs leading to the Bachelor of Science degree. Students who matriculate for the degree of Bachelor of Science may pursue majors in biological sciences (biotechnology option), chemistry, computer science, environmental science (atmospheric science, environmental studies, and geosciences concentrations), mathematics (applied mathematics, scientific computing, or statistics and operations research option), and physics (radiological health physics, optics, or applied physics option). Students should consult the Graduate School catalogue for information concerning master's programs in biological sciences, chemistry, computer science, mathematics, physics and applied physics, polymer science, radiological sciences and protection, and doctoral programs in chemistry, computer science, physics and applied physics.

In addition to satisfying general University requirements for baccalaureate degrees as defined elsewhere in this publication under the heading "Academic Policies: Baccalaureate Degrees," students who matriculate for degrees in the College of Arts and Sciences also must complete a

specific minimum number of courses and credits in the College of Arts and Sciences. These college requirements are described below. Except as specified by the college and program restrictions, students are permitted to elect any course for which they can satisfy prerequisite requirements in fulfilling an unrestricted elective requirement. However, in order to designate courses from other colleges of the University as science or mathematics courses, students must petition the chairperson of the department in which they are enrolled as majors.

Minor areas of study that are offered by the various science departments are as follows: biological sciences, chemistry, geology, mathematics, and physics and radiological health physics. College majors may also wish to consider minors offered by the social sciences, humanities, and fine arts departments, and specialized course sequences of the College of Engineering. All minor programs of the University require 18-24 credits, six of which must be at the 300 course level or above.

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide a specialized education in one or more of the basic sciences. Specialized Bachelor of Science curricula, which are offered in areas of science and mathematics, provide opportunities for major and minor program options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula.

All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the science and mathematics departments. At least three courses are required in mathematics beyond precalculus mathematics and must include two calculus courses and one additional mathematics elective.

Four science lecture courses with corequisite laboratories are required. The departmental distribution must conform to one of the following four alternatives:

1. two from each of two departments in Mathematics and Sciences;
2. four from one department in Mathematics and Sciences;
3. three from Physics and one from any

department in the College of Engineering; and

4. two from Physics and two from any one department in the College of Engineering.

For University policies concerning majors presented for the Bachelor of Science degree, see policies that appear elsewhere in this publication under the heading "Academic Policies: Major Field Requirements."

Below is a list of major fields for the B.S. degree currently offered in the College of Arts and Sciences, Division of Sciences.

Biological Science

Biotechnology Option

Chemistry

Computer Science

Environmental Science

Atmospheric Science
Concentration

Environmental Studies
Concentration

Geoscience Concentration

Mathematics

Applied Mathematics Option

Scientific Computing Option

Statistics and Operations

Research Option

Physics

Optics Option

Applied Physics Option

Radiological Health Physics
Option

College Requirements for Science Students

In order to qualify for a baccalaureate degree offered by the science and mathematics departments of the College of Arts and Sciences, undergraduates must comply with the University general education requirements, must conform to the rules of the College of Arts and Sciences that govern degree and major studies for such degrees, and must earn 2.000 averages in their major fields by the end of their senior year.

General College Policies and Requirements

To qualify for University degrees, baccalaureate candidates are required to obtain a 2.000 (C) average in their total course of study; to complete a minimum of 120 semester credits; to fulfill the minimum residency requirement designated for University day courses and for each major; to satisfy the regulations and academic standards of the colleges that exercise jurisdiction over the degrees for which they are matriculating; to complete all curriculum requirements specified by the college in which they are enrolled and department(s) in which they are majoring; and to complete the University general education requirements.

Second Majors and Minors

Options for second majors and minor studies are permitted as specified below:

1. Students may elect a second major that is offered by the College of Arts and Sciences or, upon approval of the Dean, they may elect a second major that is offered by other colleges of the University. A list of approved minors is printed below. But note that an English major may not declare a second major in American Studies; nor may an American Studies major choose a second major in English, history, political science, or sociology.

2. Students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for intercollegiate transfer. Accordingly, a student who pursues academic majors in the College of Arts and Sciences and another college is subject to all degree requirements as specified by the college of his or her initial major and is subject only to major course requirements (including any collateral and prerequisite courses for the major) as specified by the department of his or her second major. For a full discussion of University requirements concerning second majors, students should consult the relevant section of this publication, which appears under the heading "Academic Policies."

3. In accordance with the requirements of

established minor programs, students who matriculate for degrees in the College of Arts and Sciences may undertake a minor from those areas cited below that are distinct from the disciplines comprising their majors. The curriculum committee of the College will from time to time review and, when appropriate, approve new minors in addition to those listed below. Students should consult with their advisors concerning additions to the approved listing of minors. Specific options for minor programs will depend on the major field that a student has elected to pursue and the collateral course requirements that have been specified by their major departments. Students are advised that an aggregation of courses that total 18 or more credits does not constitute a minor area and they are referred to University policies, which appear elsewhere in this publication under the heading "Academic Policies: Minor Area Requirements" for further discussion. Students who wish to elect a minor program in colleges other than the College of Arts and Sciences should refer to the appropriate section of this publication concerning prerequisites, restrictions, and prescribed sequences of courses.

4. With the approval of their faculty advisors, matriculating students in the College of Arts and Sciences may develop programs of elective courses for the purpose of providing greater personal and professional relevance to their major fields. Such programs may be developed from among those disciplines that are listed above as areas in which elective courses may be authorized for matriculating students of the College of Arts and Sciences.

5. Matriculating students in the College of Arts and Sciences who do not choose to take a second major or a minor must present at least six semester credits in courses that are on the "300" level among those elective courses offered in fulfillment of collateral degree requirements.

Approved Minors

The following is a list of approved minors from which students may choose: (See also "Interdisciplinary and Intercollegiate Minors" elsewhere in this catalogue.)

American history

American literature

American studies
 art
 art history
 biological sciences
 chemistry
 classical civilization*
 clinical science
 cognitive science*
 drama
 economics
 English (general)
 English literature
 European history
 French
 gender studies*
 geology
 Greek
 history (general)
 Italian studies
 Latin American studies*
 legal studies
 mathematics (computer)**
 mathematics (general)**
 music
 music history and literature
 peace studies*
 philosophy
 physics
 political science
 psychology
 radiological health physics
 sociology
 sound recording technology+
 Spanish
 technology, society & human values*
 theater arts
 western cultural heritage*
 writing

*See listing of interdisciplinary minors at the end of the College of Arts and Sciences section of this catalogue.

**Courses for a minor area in Mathematics (including the computer programming option) require approval in advance by the Chairperson of the Mathematics Department.

+Not open to majors in the social sciences and humanities.

Declaring and Changing Major

Students who are matriculating for degrees in the College of Arts and Sciences are required to designate degree majors in the college. Although the College of Arts and Sciences does not require students pursuing the Bachelor of Arts degree in the humanities and social sciences to declare their major fields until the end of their sophomore year, students who are admitted to Fine Arts programs or Bachelor of Science programs in the sciences or mathematics are advised to declare their major fields during their freshman year and are required to make such declaration at the end of the sophomore year. Students should consult policies listed elsewhere in this publication under the heading "Academic Policies: Major Field Requirements" for a complete discussion of declaration of major, declaration of second major, and change of major with intercollegiate transfer.

Transfer Policies

Students transferring to the College of Arts and Sciences from other colleges of the University or from other institutions may expect recognition of previously completed college level courses that are applicable to the degree requirements of the College. Courses of a professional nature that are not relevant to the academic orientation of the student's major program may not be credited to the minimum degree requirement of 120 credits, and, regardless of any previous recognition by the Office of Admissions or by other colleges of the University, they may not be credited to degree requirements in the College of Arts and Sciences. Students wishing to transfer to Bachelor of Music programs are required to demonstrate their vocal or instrumental ability during an audition before the music faculty and are required to complete placement testing in music theory.

Courses from Other Institutions

The Office of Admissions initially evaluates courses that are transferred from other institutions when a student is admitted to the University. Courses are evaluated by major departments in terms of College and program requirements. Courses that are transferred to the University under provisions of the Commonwealth Transfer Compact and that are not creditable to requirements of the College of Arts and Sciences or as unrestricted elective courses will be listed on the student's permanent record but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University subsequently makes an intercollegiate transfer to the College of Arts and Sciences, all previously completed courses, including transferred courses from other institutions, will be reevaluated in terms of their applicability to degree requirements of the College of Arts and Sciences. The policy of the College is to count courses transferred to the major for the purpose of determining the student's major grade-point average.

Repetition of Transfer Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat the transferred course is granted by filing an academic petition form through the office of the college dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Arts and Sciences

Students wishing to transfer from another college of the University or from baccalaureate continuing education programs of the evening school must file an academic petition, together with a transcript, with the appropriate chairperson and the Dean

of Sciences or the Dean of Fine Arts, Humanities, and Social Sciences by November 1 for spring semester transfer and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfers, which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Deans of the College of Arts and Sciences and, irrespective of grades previously received in other college programs, all courses that may not be applied to College or program requirements are deleted from the student's cumulative grade-point average.

Pre-Professional Training

The curricula for the Bachelor of Arts and the Bachelor of Science degrees do not prescribe patterns of courses for specific vocational goals. The students in these programs receive a broad general education in the liberal arts and sciences that will prepare them for further study in professional fields at the graduate level. Students planning to enter professional fields should seek the advice of faculty advisors in the area in which they are interested, as listed below.

Law School Requirements

Pre-law work should include social sciences (especially history, economics, and political science), humanities (especially literature and philosophy), and basic courses in physical sciences and mathematics. Law schools do not specify particular majors for applicants and the field of concentration is not a determinant in admissions. Law schools do, however, vary in specific requirements and the student should, therefore, become familiar with those requirements of the schools to which he or she is planning to apply. The pre-law advisor is Dr. William Burke, Legal Studies Coordinator, Falmouth Hall, 302.

Medical, Dental School Requirements

The Council and Association of American Medical Colleges have established minimum requirements for admission to an

approved medical school. These include general and organic chemistry, biology, physics, and mathematics. These are minimums and many medical colleges require course work beyond the minimum. For this reason, it is imperative that a pre-medical student plan his or her college program in close consultation with the faculty advisor for pre-medical students. The advisor for pre-medical students is Dr. David Eberiel, Department of Biological Sciences, Olsen Hall.

Most medical and dental schools prefer a broad, liberal education in addition to specific course requirements. They do not advocate a particular major or majors and the field of concentration is not a determining factor in admission as long as the specified course requirements are met. Many pre-medical students will major in biology or chemistry, but a major in the areas of humanities and social sciences allow sufficient electives to meet the requirements of most schools. Medical and dental schools require an aptitude examination, which is ordinarily taken in the spring semester of the junior year.

Teaching Careers

The Department of Music offers the degree of Master of Music in Music Education, leading to certification for teaching music. More information about this program is available from Prof. Rosita Sands in the Department of Music.

For those students interested in teaching subjects other than music, the College of Education offers a graduate degree program designed to prepare elementary teachers and secondary teachers in art, English, mathematics, behavioral science, history, social studies, French, Spanish, biology, chemistry, earth science, and physics. This year-long program (September to June) provides the course work and the apprentice teaching experience required for certification in Massachusetts and in thirty-three other states. See graduate catalogue for requirements for admission. Interested persons may obtain additional information from the Office of the Dean, College of Education.

American Studies

Melissa Pennell, Coordinator

Executive Committee: Dean Bergeron (Regional Economic and Social Development), Mary Blewett (History), Clifford Lewis (American Studies and English), Peter O'Connell (Tsongas Industrial History Center), John Ogasapian (Music), Melissa Pennell (English). The Committee for American Studies administers a major in American Studies that leads to the Bachelor of Arts degree. The Committee also administers a minor in American Studies.

Department Location: O'Leary Library, Room 461

Telephone: (978) 934-4198

American Studies Major

American Studies allows the student who is searching for an understanding of inter-relationships among ideas, institutions, and aesthetic forms to combine a number of scholarly disciplines in order to better comprehend the many facets of American culture. By completing courses from a variety of disciplines, students in American Studies not only sharpen their analytical powers and critical insights, but will, in the long run, be well prepared for employment in education, government, social services, business, and the professions. Students who are capable of analyzing American culture by combining the conceptual approaches of a variety of disciplines - the arts, history, literature, political science, psychology, economics, sociology - are capable of making decisions with an understanding of the available alternatives. Many current problems relating to family life, medical ethics, gender and minorities, technology, the environment, international relations, government power, and the influence of business require an interdisciplinary approach. The American Studies major is a course of study through which students can obtain a broad liberal arts education. At the same time, the Committee encourages students to elect career-oriented courses as free electives. A number of American Studies majors take a portion of their free electives in management and computer pro-

gramming. Because it offers flexibility in content and design, the American Studies major is a good choice for students who are unsure about their ultimate career goals.

Major Requirements

To complete a major in American Studies, students must take 30-45 semester credits (with at least 15 credits at the 300 or 400 level).

All American Studies majors take:

1. 40.248 Values in American Culture;
2. 43.305/306 American Intellectual History, or 43.313/314 American Social History;
3. an introductory research course approved by the coordinator;
4. 40.401 American Studies Seminar, fall semester senior year.

There are two ways of fulfilling the remaining requirements for the American Studies major. Those students who chose the discipline based option take:

- one interdisciplinary 300 level course approved by the coordinator;
- two approved courses at the 300 level or above in one discipline;
- two approved courses at the 300 level or above in a second discipline.

Those students who chose the thematic option take five courses (at least three at the 300 or 400 level) related to one of the following themes:

- The City, The Environment and Technology
- Gender, Race and Class in America
- The Arts and Popular Culture in America
- Conflict and War in American Culture
- Lists of approved courses for both options are available from the coordinator.

Transfer Policy

Students transferring to the College of Arts and Sciences who wish to major in American Studies must make individual arrangements with the coordinator of the program regarding credit for major and

collateral course requirements. Some introductory courses at the 100 level may be applicable to the American Studies major, but they cannot be applied to the first 30 hours of the major.

American Studies Minor

A minor in American Studies consists of 18-24 credits selected from the list maintained by the program coordinator. These courses must include either: 43.305/306 American Intellectual History; or 43.313/314 American Social History; 40.248 Values in American Culture; and at least one interdisciplinary course.

Sample Course of Study

For students entering in Fall 1999 and subsequently

Students must take 30-45 credits in American Studies with at least 15 credits at the 300 or 400 level.

First Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Math Req1 (Gen Ed)	3
	Science1 (Gen Ed)	3
	Beginning Language I	3
	Free Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science1 (Gen Ed)	3
	Beh & Soc Studies (Gen Ed)	3
	Beginning Language II	3
	Free Elective	3
		15

Sophomore Year

Fall Semester

	Values Req2 (Gen Ed)	3
	Math or Science Req1 (Gen Ed)	3
	History Req (Gen Ed)	3
	Intermediate Language I	3

Literature Req (Gen Ed) 3
15

Spring Semester

40.248 Values in American Culture 3
Science1 (Gen Ed) 3
Beh & Soc Studies (Gen Ed) 3
Intermediate Language II 3
Free Elective 3
15

Junior Year**Fall Semester**

43.305 Am Intellectual Hist I or 3
43.313 Am Social History I3 3
300/400 American Content Course5 3
Research Methods6 3
Free Elective 3
Free Elective 3
15

Spring Semester

43.306 Am Intellectual Hist II or 3
43.314 American Social Hist II3 3
300/400 American Content Course5 3
Aesthetics (Gen Ed) 3
Free Elective 3
Free Elective 3
15

Senior Year**Fall Semester**

300/400 American Content Course5 3
40.401 Am Studies Senior Seminar8 3
300/400 American Content5 or
300 Interdisciplinary Course4 3
Free Elective 3
Free Elective 3
15

Spring Semester

300/400 American Content Course5 3
300/400 Am. Content or Free Elective3
Free Elective 3
Free Elective 3
Free Elective 3
15

Notes:

1. Consult the section on Academic Policies for the General Education requirements in mathematics and sciences.

2. 59.205 Human Values in Western Culture I or 59.206 Human Values in Western Culture II are recommended to fulfill this requirement.

3. 43.305 and 43.306 American Intellectual History or 43.313 and 43.314 American Social History.

4. One interdisciplinary 300 level course approved by the Coordinator.

5. Content courses are selected from lists of those courses approved for the thematic option or those approved from specific disciplines.

6. Students may take Research Methods in any of the following subjects: Psychology, History, Sociology or Political Science. The course may be taken in either the fall or the spring semester of the junior year.

7. 40.401 American Studies Seminar, fall semester of the senior year.

American Studies Courses (Prefix: 40)**40/42.235 Writers of the Merrimack Valley**

Writers of the Merrimack Valley is a survey of mostly contemporary regional authors. Students will read a series of books and write essays in response to reading assignments. 3cr

40/42.248 Values in American Culture

Deals with the development and interrelationship of American views on individualism, nature, science, technology, democracy, ethnicity, and the American dream. Readings begin with the Puritans and end with contemporary essayists. 3 cr.

40/42.257 The Family in American Literature

A study of literary selections dealing with traditions of family life, the individual, and social change. 3cr

40/42.314 The Twenties in America

A study of the cultural and social developments in the arts, business, entertainment, government, and science and technology during the decade. 3 cr.

40/42.315 The Thirties in America

A study of the influence of ideology on the cultural and social movements of the era. Included are the works of Dos Passos, Steinbeck, and Wright; and the films and photos documenting this era. 3 cr.

40/42.319 The American West: Myth and Reality

A study of the American West expressed in the cultural imagination of Americans. Readings and documentaries about the arts, exploration, water resources, urban life, ethnic cultures, and feminist influences offer contrasting perspectives to the western myth. 3 cr.

40/42.333 American Autobiography

A study of autobiographical writing from Colonial America to the present. Works from Franklin, Angelou, Mead, and Mangone (to cite a few) represent the pluralistic view of what it means to be an American. 3 cr.

40.335 Themes in American Civilization

A study of essays, fiction, and documentary films reflecting the aspirations of Americans including their religious, economic, political, and social perspectives with emphasis on the shaping influences of nature and science and technology. 3 cr.

40.340 Cross-Cultural American Literature

A study of essays, fiction, poetry, and plays reflecting the multicultural American experience, with emphasis on Native-, European-, African-, Latino-/Chicano-, and Asian-American authors. 3 cr.

40.350 Contemporary Issues in American Civilization

Looks at various contemporary issues from an interdisciplinary view. The course consists of both readings and talks from experts in the field. 3 cr.

Seminar**40.401 American Studies Seminar**

A required seminar for American studies majors normally taken during the second semester of the junior year or during the senior year. Students undertake a research project leading to the writing of a major paper with a theme that combines more than one discipline. 3 cr.

Directed Studies

Directed studies courses are available only to majors in American studies and may be

elected provided that 1) the material to be covered is not available in any course offered during the semester in which the directed studies course is contemplated, 2) instructors are willing to undertake a directed studies course, and 3) no more than nine credits in the major field are acquired in directed studies courses.

40.491 Directed Studies in American Studies

An investigation of a topic using an interdisciplinary approach and leading to the writing of a major paper. The course provides an opportunity for a student to work closely with an instructor on a topic of special interest. Prerequisites: 40.401 and permission of program coordinator and instructor. 3 cr.

40.495 Advanced Tutorial in American Studies

A program of directed studies in which the student, in consultation with the instructor, investigates one or more topics and presents several critical essays that evaluate the readings. Prerequisites: demonstrated proficiency in the areas selected for study and permission of the instructor. 3 cr.

Practicum

40.496 Practicum Experience in American Studies

Allows students an opportunity to combine their formal education with an off campus project. After developing a proposal for the practicum under the guidance of an instructor, the student spends a portion of his or her time working with persons engaged in business, the arts, museums, the professions, community service, or government. The coordinator for American studies maintains a file of organizations that accept students. 3 cr.

Department of Art

James Coates, Chairperson

Professors: James Coates, Fred Faudie, Arno Minkkinen, Brenda Pinardi, Carlton Plummer (Emeritus)

Associate Professors: Robert Griffith (Emeritus), James Veatch

Assistant Professor: John Craig Freeman

Department Location: McGauvran Student Union, Room B11

Telephone: (978) 934-3494

Mission

It is the purpose and mission of the Art Department at the University of Massachusetts Lowell to welcome high school and transfer students of emerging and/or promising artistic talent into a rigorous, career-driven, humanities-inspired four-year program of studio art and art-based academic studies. Throughout history as we know it, the finest expression of human culture and scientific knowledge has been made manifest through works of art. It is through art that society not only communicates, but also celebrates its desire for goodness, beauty, and understanding. To this end, a dedicated and long-associated team of professionally practicing art professors, along with their colleagues in computer science, literature, philosophy, music, history and the social sciences, seeks to provide students with the instructional training, academic guidance and professional expertise necessary to lead successful and enlightened lives as visual artists and designers in the career-dominated, visually-oriented, and increasingly competitive global world of the 21st century.

Art Major

The art major is designed to develop a discriminating appreciation of art and a knowledge of the technical requirements for succeeding as educated artists. To foster these abilities and to promote analytical and aesthetic understanding, the program provides a foundation in both the theoretical and practical aspects of art. The Art Department offers the professional degree of Bachelor of Fine Arts. The

department also offers minor programs in studio art. A major in art provides students the opportunity to prepare for careers in fine arts, computer-based illustration and graphic design, computer-based interactive-media, animation, community oriented art programs, gallery work, museum research, photography related occupations, teaching, and graduate study in art.

Accreditation

The Art Department of the University of Massachusetts Lowell is an accredited member of the National Association of Schools of Art and Design.

Bachelor of Fine Arts: Major Requirements

This program is designed for students who seek knowledge of the basic art processes and an opportunity to develop concentrated skills in an area of concentration within the Fine Arts or Graphic Design degree areas. The total of art studies cannot exceed 87 credits unless the student completes additional non-art credits equal to the number of credits by which the art credits exceed the 87 art credit maximum. A minimum of 33 credits must be completed as part of the University General Education requirement.

BFA studies consist of 75 studio credits and must include at least five courses (15 credits) at the 300 level or above, plus the following requirements:

1. Six Studio Foundation courses (18 credits): Art Concepts I and Art Concepts II, Art Concepts Colloquium, Form and Content, Drawing/Form and Space, and Concept Drawing.
2. Fourteen courses are required within the student's chosen concentration of Fine Arts or Graphic Design (42 credits). Students may choose to focus their concentrations in advertising design, animation, cartooning, digital imaging, drawing, graphic design, illustration, interactive-media, painting, photography, sculpture or web design.

The following are sample programs; specific programs are individually structured with the aid of the student's academic advisor and the permission of the Senior Studio Review Committee.

Fine Arts Concentration in Painting (example)

- 70.259 Papermaking
- 70.261 Photography I
- 70.267 Printmaking
- 70.271 Painting I
- 70.273 Watermedia
- 70.275 Sculpture
- 70.369 Monotypes
- 70.370 Figure Drawing
- 70.371 Painting II
- 70.492 Advanced Studio in Sculpture
- 70.492 Advanced Studio in Painting
- 70.494 Directed Studies in Painting
- 70.495 Advanced Tutorial in Painting
- 70.496 Practicum Experience/Internship in Studio Art

Graphic Design Concentration in Advertising Design

- 70.230 Typography
- 70.261 Photography I
- 70.262 Digital Imaging and Photography
- 70.265 Computer Art I
- 70.361 Photography II
- 70.365 Computer Art II
- 70.376 3D Modeling and Animation
- 70.390 Illustration
- 70.391 Advanced Graphic Design
- 70.395 Advertising Design
- 70.397 Art and Copy
- 70.492 Advanced Studio in Advertising Design
- 70.494 Directed Studies in Art and Copy
- 70.496 Practicum Experience/Internship in Studio Art

3. Senior Studio Requirements (15 credits):

All courses under this requirement must be taken with the advice and consent of the student's academic advisor and of the Senior Studio Review Committee. Continuation in the BFA program is dependent on approval by the Review Committee at the end of the first 3 credit hours. An exhibition of work is required

as part of Senior Studio in the student's final semester.

- 70.497.801 - 3 credit hours
(last semester of junior year)
- 70.497.802 - 6 credit hours
(first semester of senior year)
- 70.497.802 - 6 credit hours
(last semester of senior year)
- 4. Art History / Aesthetics and Critical Studies requirements (12 credits):
Survey of Art I (Prehistoric to Medieval Art) Survey of Art II (Renaissance to Modern) and two Aesthetics and Critical Studies elective courses (one at the 300 level).

Students who wish to pursue the Bachelor of Fine Arts degree must meet the following standards and requirements:

1. Completion of the Art Department foundation studio course requirements (18 credits);
2. Completion of the two course Survey of Art sequence (6 credits);
3. Completion of a combination of upper level studio art courses selected in consultation with their academic advisor and which are appropriate to the intended concentration;
4. Maintenance of a semester grade point average of 2.00 for all art courses.
5. Presentation of a portfolio and formal letter of application to the Senior Studio Review Committee at the completion of 75 credits of study. Students who have satisfied these requirements are permitted to enroll in their first course of Senior Studio (3 credits) as a conditional Senior Studio enrollee. Students matriculated in the BFA program must earn a C (2.0) or better in each enrollment of Senior Studio, and must receive a recommendation for continuance at the end of each semester from the Senior Studio Review Committee. A student who fails to achieve the required grade point average or who is not recommended for continuation by the Senior Studio Review Committee will be dismissed immediately from the BFA program.

Senior Studio courses are, with the exception of the first conditional three credit

course, regarded as professional courses and for this reason are restricted to matriculating BFA majors only and may not be credited to any other curriculum. In the event that a matriculating BFA student transfers or is dismissed from the BFA program, semester course credits earned in subsequent Senior Studio courses may not be credited to degree programs either in the Art Department or elsewhere in the University. Senior students should be aware that transferring from the BFA program to another degree major will normally entail a loss of credits and that the completion of degree requirements within the customary four year period may not be possible.

Students admitted to the BFA program are exempt from a language requirement.

Portfolio Requirements

While a portfolio is not required for freshman admissions into the art program, a portfolio is recommended to properly place new students in their course sequence.

Transfer students from compact colleges are not required to present a portfolio and will have their credits accepted when course work has an equivalent to or direct correlation with UML course work, provided that the grades meet the C- minimum accepted by the University.

Transfer students from non-compact colleges are not required to present a portfolio and will have their credits accepted when course work has an equivalent to or direct correlation with UML course work, provided that the grades are honors grades of B or above. A portfolio must be presented for course work that received a grade lower than a B (and within the C- minimum accepted by the University).

Students transferring from pass/fail programs or where further clarification of course work is needed will be asked to present portfolios for transfer evaluation.

When preparing portfolios, slides should be individually labeled and should be submitted in slide sheets and consist of representative samples of work executed in high school or at the student's previous institution.

Minor Requirements

A minor in studio art consists of 18-24 credits selected in accordance with the following specifications: 15-21 credits must be completed in studio art courses and at least one Aesthetics and Critical Studies course must be completed. No fewer than six semester credits of the minor must be at the 300 level or above.

European Summer Program

The Art Department offers photography courses for credit in various countries in Europe during the summer. The courses generally take place in Finland, Italy and Switzerland.

Registration for Art Courses

The Art Department reserves the right to pre-register its major students in order to assure completion of their degree requirements. In the event of over-subscription of art courses by art majors, the department will grant first preference to seniors and second preference to juniors.

Policy Concerning Student Work

The Art Department reserves the right to keep student work for a period not to exceed one year for inclusion in exhibitions. The department reserves the right either to photograph student work for its slide collection or, in the case of photography, printmaking and computer courses where many copies can be made, to keep actual examples of work. Unless otherwise specified, artwork and term papers left for more than one semester following the semester in which they were completed become the property of the Department.

Senior Studio students must submit visual documentation of their course work; this documentation becomes part of their department records.

Academic Integrity

Students should be aware of the issues of creative honesty and of the prohibition against the unwarranted use of the work of others, of the dishonesty of misrepresenting the source of work and ideas, and of the penalties established by the University for cheating and plagiarism. The department expects that work passed in by the student will be the product of the student's own effort. Particulars of the University policy on academic dishonesty can be found elsewhere in this bulletin.

Equipment Care and Replacement Repair

The Art Department has limited resources which allow it to provide equipment for student use. Students are responsible for replacement costs of any items which they lose or damage in the course of their studies.

Studio Art Courses (Prefix: 70)

70.101 Art Concepts I

Art Concepts I will focus on learning the visual language of the creative process through an examination of the principles of two-dimensional visual organization. These fundamental basics form the underlying structure of all studio and communication arts. Through slide lecture, guest lecturers, field trips, and studio projects, students will begin to understand the many forms that visual expression takes. The course will develop creative problem solving skills and students will learn to respond to personal challenge. Students will also be instructed in the principles of professional execution and be introduced to diverse modes of thought, media, and aesthetic expression. Art majors only. Fall and Spring. 3 cr.

70.102 Art Concepts II

Art Concepts II will focus on learning the visual language of the creative process through an examination of the principles of three-dimensional visual organization. These fundamental basics form the underlying structure of architecture, environmental graphic design, product design and sculpture. Through slide lecture, guest lecturers, field trips, and studio projects, students will begin to understand the many forms that three dimensional expression takes. The course will develop creative problem solving skills and students will learn to respond to personal challenge. Students will also be instructed in the principles of professional execution and be introduced to diverse modes of thought, media, and aesthetic expression. Art majors only. Fall and Spring. 3 cr.

70.111 Art Concepts / Colloquium

The colloquium component of Art Concepts will introduce the student to the major occupations in the fields of art and design and continue to introduce diverse modes of thought, media, and aesthetic expression. The course will also give stu-

dents exposure to the art resources of the region including museums, galleries and art supply stores. Through a series of slide lectures, visiting artists, films, field trips, studio projects and writing assignments students will develop critical and analytical observation and thinking skills. Fall and Spring. 3 cr.

70.201 Form and Content

Form and Content is considered the capstone course of the Art Foundations Requirement. Through a variety of studio assignments and individual projects students will explore the integration of humanities related concepts and develop an understanding of how visual artists think, live and function in the twenty first century. As part of the course requirements students will participate in the foundations exhibition at the end of the semester. Art majors only. Fall and Spring. 3 cr.

70.230 Typography

The study of lettering concepts and techniques, including the history of letters, styles and families of type, letter design, hand-drawn to computer-based lettering approaches and their effect and uses in communication. Emphasis will be on creative and aesthetic communication. Fall, alternate years. 3 cr.

70.253 3D Design

A study of the visual elements and the basic design principles involved in the composition of three-dimensional objects. Emphasis will be placed on materials exploration, the development of problem-solving skills, perception, awareness and sensitivity to our visually, object-oriented environment. Fall and Spring. 3 cr.

70.255 Drawing - Form and Space (replacing Drawing I)

A foundation course in basic concepts, focusing on the translation of the three dimensional world to the two dimensional surface. Through a variety of media, surfaces, and approaches students will concentrate on building visual literacy and its application to the realm of ideas. A wide range of assignments is given to develop graphic expression. Fall and Spring. 3 cr.

70.259 Papermaking

The papermaking course is designed to explore paper, not just as a surface to receive an image, but as a material capable of being an artistic expression in and

of itself. The course will explore the processes and techniques of making images in handmade paper, making images on handmade paper, making visual designs out of handmade paper and casting handmade paper into three-dimensional sculptural forms. Spring, alternate years. 3 cr.

70.261 Photography I

A foundation course that covers the basic camera and darkroom techniques as well as aesthetic principles. Emphasis will be on black and white film and paper emulsions. Students learn to develop and print their own photographs. Fall and Spring. 3 cr.

70.262 Digital Imaging and Photography

This course will offer the student a transition between traditional photographic imaging and digital photographic imaging. The course will cover the fundamentals of digital scanning, digital capture and image manipulation. Image preparation for other media will also be explored. Basic familiarity with the Mac OS is required. Prerequisite: 70.261 or permission of the instructor. 3 cr.

70.265 Computer Art I

An aesthetics and communications course using the computer as the primary tool for translating art ideas into physical form. The emphasis will be on practical usage of existing Macintosh software as a means of creation. Prerequisite: 70.251 and/or 70.255 or permission of the instructor. Fall. 3 cr.

70.267 Printmaking

An introduction to basic printmaking processes and aesthetics with the emphasis on etching. The approach is concept oriented, emphasizing experimentation and exploration on an individual level to communicate ideas. Fall. 3 cr. Prerequisite: Art Concepts I and II or 70.255 or permission of instructor

70.269 Color

A course in the systematic study of color and color theory to sharpen visual acuity, stimulate creativity and develop a greater facility in the use of color. Spring. 3 cr.

70.271 Painting - Form and Space (replacing Painting I)

The aesthetics of spatial and shape translation using oil paint as a vehicle for expression is the basis of the course.

Through a series of challenging projects, both assigned and independent, students will work with the fundamentals of visual organization and paint handling. Fall and Spring. 3 cr. Prerequisite: Art Concepts I and II or 70.255 or permission of instructor

70.273 Narrative Painting (replacing Watermedia)

Prose and Poetry as artistic inspiration forms the basis for the course. Students will work with a variety of themes in basic water-based media using their own as well as the writings of others as a departure point. The analysis of visual symbol and allegory to interpret the written word will be an integral part of the instructor assigned and self-assigned projects. Spring, alternate years. 3 cr. Prerequisite: completion of the UML literature requirement, plus Art Concepts I and II or 70.255 or permission of instructor

70.275 Sculpture I

The exploration of three-dimensional form through the use of basic materials, methods and approaches. Assignments will include expressive problems based on human and non-objective form relationships. Fall and Spring. 3 cr.

70.281 Ceramics I

Ceramics will introduce the student to the basic handbuilding techniques, wheel throwing and ceramic sculpture. The course will also examine clay, the material, glaze techniques and firing processes. Fall, alternate years. 3 cr.

70.299 and/or 70.399 Studio Workshop

Study of studio problems in visual structures and organization with various media and techniques; contemporary practices and issues will be explored. Topics will vary. This course may be repeated. Prerequisite: 70.251, 70.253, and/or 70.255 or permission of instructor. Fall and Spring. 3 cr.

70.351 Advanced Studies in Visual Design

An advanced study of design principles and how they articulate structure, space and form. The emphasis is on development of a personal approach to design principles. Prerequisite: 70.251 or permission of instructor. Spring, alternate years. 3 cr.

70.355 Concept Drawing (replacing Drawing II)

The emphasis is on giving form to ideas through building a solid sense of visual literacy. Assignments include a wide range of color media, surface, and subject matter with the focus on the psychological and structural use of color, creative experimentation, and the development of personal style. Prerequisite: Art Concepts I and II or 70.255 or permission of instructor. Fall and Spring. 3 cr.

70.359 Sculpture II

A course allowing the student to further develop his or her techniques and understanding of sculptural form, leading to a more personal vocabulary. Conventional techniques will be extended to cover more contemporary materials and methods. Prerequisite: 70.275 or permission of instructor. Spring, alternate years. 3 cr.

70.361 Photography II

An advanced course in black and white photography that includes instruction in technique and vision. Emphasis will be on development of a cohesive body of work in photography. Prerequisite: 70.261 or permission of instructor. Spring. 3 cr.

70.365 Computer Art II

Designed to focus on advanced projects using the Macintosh platform. Focus is on design, layout, animation and video. Prerequisite: 70.251, 70.255 and 70.265 or permission of instructor. Spring. 3 cr.

70.369 Monotypes

Exploration of the one-of-a-kind "painter's print." Emphasis is on the development of personal expression through a variety of assignments and techniques. Three portfolios of prints are required, two with assigned topics, and one with a self-assigned theme. Prerequisite: Art Concepts I and II or 70.255 or permission of the instructor. Fall, alternate years. 3 cr.

70.370 Figure Drawing

The study of the draped and undraped figure from life, stressing both sound observation and the creative use of human form as a vehicle for personal expression. A variety of assignments, graphic media, and approaches will be given in order to help explore both philosophical and aesthetic issues. Prerequisite: 70.255 or permission of instructor. Fall, alternate years. 3 cr.

70.371 Concept Painting (replacing Painting II)

Designed to allow students to develop individual style and approach to content through a series of self-initiated paintings. Students will work closely with the instructor to develop a cohesive series that has a sound philosophical and aesthetic basis. Prerequisite: 70.271 or permission of instructor. Spring, alternate years. 3 cr.

70.372 Cartooning

The course is designed to develop skills and techniques essential for appreciating and producing cartoon forms for publication and advertising. Special topics to be covered are politics, sports, panel humor, advertising, and comic strips. Original cartoon work will be done in black and white, and color; computer output will be explored. Prerequisite: 70.255 or permission of instructor. Spring. 3 cr.

70.373 Professional Studio Photography

A professional level course in advertising product and studio portrait photography. Students will learn view camera techniques as well as principles of lighting using strobe equipment. Fall, alternate years. 3 cr.

70.375 The Language of Video

An introductory course in video camera principles and editing functions. Utilizing writing and still photography, students will explore the language of video in both images and sound as they produce factual documents and/or personal fiction. Prerequisite: 42.101, 70.361 or permission of instructor. Spring, alternate years. 3 cr.

70.376 3D Modeling and Animation

Students will learn the fundamentals of computer generated 2D and 3D modeling and animation. Projects will include 3D oriented print ad development and 3D digital animation video clips. Prerequisite: 70.265. Fall. 3 cr.

70.377 Advanced Animation

This advanced-level course is designed for students who have completed 3D Modeling and Animation and who are interested in exploring the narrative possibilities in animation. Conceptual drawings and storyboarding will be required. The course will cover advanced sequencing, motion paths, editing, audio, and virtual environments. Other course topics will

include media preparation for output to film, video, and CD-ROM. Prerequisite: 70.265 and 70.376. Spring. 3 cr.

70.378 Interactive Game Design

This course will introduce the students to the processes of game conceptualization and game prototyping. Immersive and interactive media will be explored.

Interactive, engaging game design will be emphasized. Conceptual drawings, storyboarding, 3D modeling, immersive photography and multi-media authoring will be employed. Prerequisite: 70.265, 70.376 and 70.377. Fall. 3 cr.

70.379 WEB Design

This course will focus on the creation of visual content for the web. The course will explore what constitutes a visually exciting and engaging site. Students will learn HTML, GIF/JPEG file formats, WEB color strategies and platform standards. Prerequisite: 70.262 and 70.265 or permission of instructor. Fall and/or Spring, 3 cr.

70.381 Advanced Game Design

This advanced level course is designed for students who have completed Interactive Game Design and who are interested in exploring interactive game strategies, multi-level game design and conceptualization. Prerequisite: 70.377 and 70.378. Spring. 3 cr.

70.384 Advanced WEB Design

This advanced level course is designed for students who have completed WEB Design (70.379) and who are interested in exploring more advanced levels of website development. This course will introduce cascading style sheets, animated .gifs, embedding and advanced color strategies. Prerequisite: 70.379. Spring. 3 cr.

70.385 Streaming Media for the Web

This is an advanced course for those with intermediate or advanced ability in World Wide Web technology who want to explore the use of continuous feed, streaming audio, video and 3D virtual worlds. The course will examine current technologies with special attention to emerging protocols and standards for audio and video publishing. Prerequisite: 70.379, 70.381 and 70.384. Spring. 3 cr.

70.390 Illustration

This course provides students with a variety of experiences involving skills and techniques including computer use related to the execution of illustrations for chil-

dren's books, fashion drawings, record albums, book jackets, folders, posters, and magazines. Field trips, discussions related to job opportunities and preparation of portfolios are integral parts of the instruction. Prerequisite: 70.251, 70.255 and/or 70.273 or permission of instructor. Fall. 3 cr.

70.391 Advanced Graphic Design

In this course students will be assigned a variety of advanced-level projects dealing with areas such as logo design, publication design, interactive screen design, direct mail projects, corporate identity systems, poster design and more. Assignments in this course are designed to better develop the students' ability to take a project to its final stage and render it as a professional portfolio piece. Prerequisite: 70.230, 70.265 and 70.365 or permission of instructor. Spring. 3 cr.

70.395 Advertising Design

Instruction in lettering, layout of commercial media as well as in the creative aspects of advertising are an integral part of the course. Practical problems, field trips, and technical guidance from preliminary layouts to finished work will help prepare students for the commercial art field. Prerequisite: 70.230, 70.251, 70.255, and/or 70.261 or permission of instructor. Spring. 3 cr.

70.398 Art and Copy

The real world of advertising incorporates selling words and memorable images in a dynamic visual/verbal design unit. As copywriters and art directors, students learn to think pictures and see words as they prepare advertising campaign concepts for a variety of products and media, including print and television. Prerequisite: 70.230, 70.251, 70.255 and/or 70.261 or permission of the instructor. Spring, alternate years. 3 cr.

70.398 The Documentary Image

In a world of increasing manipulation, documentary photographs still astound us with their visual truths. In this course, students will utilize words and images - the primary tools of the photojournalist - to explore the significant issues of our time. Works by Fenton, O'Sullivan, Gardner, Riis, Hine, Bourke-White, Lange, Smith, Davidson, Salgado, Mark and others are studied for content, style, and inspiration. Prerequisite: 42.102 and 70.261 or permis-

sion of the instructor. Fall, alternate years. 3 cr.

70.492 Advanced Studio

In order to enable students to expand expression in areas of their choice, they may repeat any studio course that is the most advanced offered in that given subject. They will be given more freedom within assignments and be expected to perform on a more advanced level. Prerequisite: permission of instructor. Fall and Spring. 3 cr.

Individual Studies

Individual study courses are available only to art majors and may be elected provided that 1) the material to be covered is not available in departmental course offerings, 2) instructor is willing to undertake a directed studies course, and 3) no more than six hours of credit in the major field is acquired through directed studies courses, excluding Senior Studio and Practicum.

70.494 Directed Study in Studio Art

A special problem in studio art is investigated through conferences and studio work. Prerequisite: permission of instructor. Fall and Spring. 3 cr.

70.495 Advanced Tutorial in Studio Art

A program of directed studies which afford the advanced students an opportunity to pursue a previously explored problem in greater depth. The purpose is to sharpen and refine skill, content and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. Fall and Spring. 3 cr.

70.496 Practicum Experience in Studio Art

A program of on-campus and/or off-campus experiences for art majors only. Specific requirements will vary depending upon departmental policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and/or for learning of skills through temporary placement in the field. All Practicum Experiences must be approved by the Art Department, and may be repeated to a maximum of nine credit hours. Practicum Experience may not be substituted for a required course in the major.

Prerequisite: permission of Department Chairperson and supervising instructor. Fall and Spring. 3 or 6 cr.

70.497 Senior Studio

This course is designed to culminate four years of art experience for the BFA studies. The development of personal approach to media and idea is emphasized. Each student will be responsible for developing a self-assigned thematic concern. No assignments will be made by the instructor who will act only as an advisor and coordinator. Course evaluation is by the Senior Studio Review Committee. Enrollment restricted to majors in BFA program. Staff. Fall and Spring. 3 & 6 cr.

Aesthetics and Critical Studies Courses(Prefix: 79)

79.221 Aesthetics And Critical Studies of Contemporary Art

A study of the relationships of contemporary movements in painting, sculpture, architecture, cinema, and multi-media. Emphasis is placed on analysis of contemporary usage of art movements. 3 cr.

79.225 Aesthetics And Critical Studies of Photography

A survey and analysis of photography that concentrates on the aesthetic development of the medium concepts from the camera obscure to today's digitized imagery. European as well as American photographers will be studied ranging from Niepce, Daguerre, and Talbot to Adams, Arbus, and Mapplethorpe. 3 cr.

79.352 Aesthetic Concepts: Critical Issues:

Examination of issues of content, theory, and criticism in contemporary and traditional art and culture. Topics vary. 3 cr.

79.360 Aesthetics And Critical Studies of Graphic Design

Examination of the aesthetic theories and practice of graphic design. Significant practitioners of the art will be highlighted. 3 cr.

79.361 Aesthetics And Critical Studies of New Media

Examination of the aesthetic theories and practice of new media. Significant practitioners of the art will be highlighted. 3 cr.

79.362 Aesthetics And Critical Studies of Illustration

Examination of the aesthetic theories and practice of illustration. The work of master illustrators will be examined. 3 cr.

79.490 Aesthetics and Critical Studies Seminar

Study of particular aesthetic concepts. Prerequisite: permission of instructor and department. Topics vary. 3 cr.

Directed Studies

Directed study courses are available only to art majors and may be elected provided that 1) the material to be covered is not available in departmental course offerings, 2) instructor is willing to undertake a directed studies course, and 3) no more than six hours of credit in the major field is acquired through Aesthetics and Critical Studies enrollments.

79.494 Directed Study in Aesthetic Concepts

An individual supervised research project relating to questions of aesthetic interpretation and understandings. Prerequisite: permission of instructor and Department. Fall and Spring. 3 cr.

79.496 Practicum Experience in Aesthetic Concepts

A program of on-campus and/or off-campus experiences for art majors only. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or credits. Students will be graded "satisfactory" or "unsatisfactory." Prerequisite: permission of the Department and instructor. Fall and Spring. 3 cr.

Art History Program

Liana De Girolami Cheney, Coordinator

Professor: Liana De Girolami Cheney

Department Location: Coburn Hall, Room 201

Telephone: (978) 934-3495

Art History is a humanistic discipline that is philosophically related to the liberal arts. It aims to study the arts in relation to the life and time out of which they spring from western and non-western cultures. It includes a comprehensive study of the historical periods, cultural expressions, aesthetic judgments, and artistic choices manifested in architecture, painting, sculpture, graphics and related processes, and artifacts from Ancient to the present.

By examining the intellectual and scientific events that have shaped the creation of art and civilization, students are able to assess aesthetically and critically the artistic products of past and present cultures. Art History assist students to develop aesthetic and critical judgments as well as writing and verbal skills.

Programs in Art History

In the College of Arts and Sciences two concentrations are offered in Art History under baccalaureate degree programs of Bachelor of Arts in the Department of History (see History Department), and Bachelor of Liberal Arts. A minor is also offered in Art History. For information about the Art History concentration in the history major, see the listing under History.

Concentration in Art History within the Bachelor of Liberal Arts Program

The art history concentration is designed to develop and foster historical, aesthetic and multicultural appreciation of art as well as analytical, critical and theoretical knowledge of art. See the requirements for Bachelor of Liberal Arts under "Liberal Arts."

An art history concentration in the Bachelor of Liberal Arts consists of 24-30 credits (8 to 10 courses) distributed with

the following requirements; all courses are selected in consultation with the Art History Coordinator:

1. Two Foundations of Art History courses (6 credits)

Survey of Art I and Survey of Art II

(All art history students must take Survey of Art I and II prior to enrolling in the upper level art history courses.)

2. Art History Elective (15 to 18 credits or five to six courses, from this selection, must be at the 300 level and above)

3. Practicum in Art History (3 credits or one to two courses)

4. In the junior year Essay Writing for Non-Majors is required for all Bachelor of Liberal Arts students

Reading knowledge of a foreign language is strongly encouraged

Art History Minor

A minor in art history consists of 18-24 semester credits selected in accordance with the following specifications: two foundation art history courses (Survey I and Survey II), plus 12 to 18 credits must be completed in art history courses, and no fewer than six semester credits offered for the minor shall be completed at the 300 level or above. Practicum in art history is strongly encouraged. Course work is selected in consultation with the Coordinator of Art History.

Internships

Open to all art history students who wish to develop special skills in museum research, curatorial experience or slide librarian apprenticeship in local museums, art corporations or private industry.

Honors Program

Students who wish to receive advanced excellence in Art History may enroll in the Honors Program and attend classes under such coding. Under the tutorship of an art historian, an Art History thesis on a specific theme, art theory or artist is required by the completion of the program.

Transfer Students

Students transferring to the College of Arts and Sciences and wishing to concentrate in Art History must make individual

arrangements with the Art History Coordinator regarding satisfaction of art history course requirements.

European Summer Program

Art History courses for credit are offered in various countries in Europe during the winter and summer sessions. The art history courses generally take place in England, France, Italy and Greece.

Art History Club

The Art History Club provides an opportunity for all art history students to participate in field trips, conferences and symposia as well as visiting exhibition and museums in New England, New York, and Washington DC.

Art History Courses (Prefix: 58)

58.101 Art Appreciation

The course introduces the student to the technical, aesthetic and historical aspects of architecture, sculpture and painting. An analysis of the visual elements used in fine arts such as color, line, shape, texture and principles of design are developed through slide lectures, museum visits and assigned readings. In addition, students investigate the purposes of art and visual communication and develop a heightened sense of critical thinking that allows them to investigate successfully different modes of representation, styles and media in a multicultural society.

Fall and Spring

3 cr.

58.105 Comparative Arts

This course studies the aesthetic, artistic and intellectual similarities between art history and music history. Discussion of the arts focuses on the development in examining the human creativity and expression through the arts: from ancient times as 'art and morality' followed in the Renaissance as 'art and sciences' continued in the Enlightenment as 'art and society' contrasted in the nineteenth century as 'art and entertainment.' Furthermore, this course surveys some of the fundamental aspects of music and art, such as the nature of aesthetic judgment, the task of art and music criticism, including formalist, representational, and contemporary theories on viewing, analyzing, and interpreting the arts. In addition, with a comparative analysis between the modes

of visual and aura representation, visual and aura perception, this course analyzes the principal forms and genres of the visual and aural elements of art history and music history, providing an understanding for human creativity and expression. Spring, alternate years. 3 cr.

58.203 Survey of Art I: Prehistoric to Medieval Art

A survey of the major western and non-western arts from earliest time to the Middle Ages presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic analytical, critical and art historical methods. Fall semester 3 cr.

58.204 Survey of Art II: Renaissance to Modern

A survey of the major western and non-western arts from Renaissance to the twentieth century presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic analytical, critical and art historical methods. Spring semester 3 cr.

58.205 Studies in World Art

Historical and critical examination of regions works of art from China, Asia, India, Africa, North America, Latin America, and Mexico. Topics vary from year to year. Course may be repeated. Pre-requisite: permission of instructor. Spring, alternate years, 3 cr.

58.205(A) Mexican Muralists

Examination the dominance of Mexican Muralists in the visual and aesthetic culture in Latin America in the early twentieth century. Discussion on the implication of the social revolution and political sentiments on Mexican murals representations. Also stylistic and iconographical analysis of the Muralists, such as Diego Rivera, Jose Clemente Orozco, David Alfaro Siqueiros, Rufino Tamayo as well as Frida Kahlo will be studies in relation to past muralist traditions.

58.205(B) Primitive Art: Method and Theory

The purpose of this course is to provide a general overview of the art of the traditional cultures of Africa, North American

and the South Pacific. This overview will be presented within a critical framework that questions the relationship between "civilized" viewers and so-called "primitive" art.

58.205(C) Asian Art

The purpose of this course is to provide a general overview of the art of the traditional cultures of Asia, China, India and Japan. This survey provides a critical and historical examinations of these cultures.

58.206 History of Architecture

A survey of the major technical and stylistic developments in ecclesiastical and secular architecture from Prehistory to the present day are studied with an emphasis on the major monuments (Parthenon, Pantheon, Gothic Cathedrals, St. Peters, Versailles Palace, Eiffel Tower, Guggenheim Museum).

Spring, alternate years, 3 cr.

58.211 Nineteenth Century Art

A study of the nineteenth century European painting, sculpture, and architecture are analyzed, including the art of Neoclassicism, Romanticism, Realism, Impressionism, Post-Impressionism, Symbolism and Art Nouveau.

Fall, alternate years, 3 cr.

58.221 Twentieth Century Art

A study of American and European movements in painting, sculpture and architecture from 1900 to the present. Emphasis is placed on Fauvism, Cubism, Expressionism, Surrealism, International Style, Pop, Op Art, Minimal Art, Surrealism, Photorealism and Post-Modernism.

Spring, alternate years, 3 cr.

58.231 Greek and Roman Art

A study of Greek painting, sculpture and architecture from the Cycladic to the Hellenistic period, and an examination of Roman Art from the Etruscan Age to the beginning of Christian art. Emphasis is placed on the Greek Classical period and the Roman Empire.

Fall, alternate years, 3 cr.

58.241 Medieval Art

A survey of architecture, sculpture and painting of Early Christian, Byzantine, Carolingian, Romanesque and Gothic periods from the fourth to the fourteen centuries in relationship to philosophical and socioeconomic developments. Emphasis

on Hagia Sophia, Aachen Chapel, Saint Denis and the French cathedrals.

Spring, alternate years, 3 cr.

58.305 Theater in the Arts

Students will explore the ways in which theater and the visual arts enhance and stimulate language acquisition and critical literacy development as well as promote the development of a sense of historical awareness and cultural identity.

Spring, alternate years, 3 cr.

58.308 Art, Science and Technology in the Renaissance

From Filippo Brunelleschi's first perspective experiments to Leonardo da Vinci's prolonged study of human anatomy and optics, Renaissance artists exhibited unprecedented interest in the scientific nature of light, color, space, and form as they affected artistic creativity. At no other time in history were technology, science and art so closely interconnected. Discussion will focus on the achievement of Italian artists of the fifteenth and sixteenth centuries as they attempted to translate their new scientific understanding of the world.

Fall, alternate years, 3 cr.

58.313 American Art

The study of American painting, sculpture and architecture from the Colonial Period to the end of the nineteenth century seen in relation to European developments and American social and technological changes. Emphasis is placed on New England architecture. Prerequisite: 58.101 and/or 58.211 or permission of instructor.

Spring, alternate years, 3 cr.

58.321 Italian Renaissance Art

A study of painting, sculpture and architecture in Florence, Rome and Venice during the fifteenth and sixteenth centuries. Special emphasis on the formation of the High Renaissance style and the role of representative artists of the period, such as Leonardo, Michelangelo and Raphael in Central Italy; Giorgione and Titian in Venice. Fall, alternate years, 3 cr.

58.323 Northern Renaissance Art

Development of Flemish and Dutch painting from the brothers Jan van Eyck and Roger van der Weyden to Bosch and Bruegel, from the late fourteenth century to mid-sixteenth century. The course will also include a study of French and

German painters of the same period: Fouquet, Clouet, Durer, Grunewald and Holbein. Prerequisite: 58.101 and/or 58.204 or permission of instructor. Spring, alternate years, 3 cr.

58.330 Italian Mannerism

A study on the impact of the High Renaissance in the sixteenth century, the subsequent development of early Mannerism in central Italy and the formation of the Proto-Baroque style in Venice and Northern Italy, the establishment of the courtly Mannerist style. The role of representative artists such as Anguissola, Pontormo, Rosso, Parmigianino, Bronzino, Beccafumi, Fontana, Vasari, Veronese, Bandinelli, Cellini, Palladio, Peruzzi and Ammanati is emphasized. Spring, alternate years, 3 cr.

58.332 Baroque Art in Italy

The development of painting, sculpture and architecture in Italy during the seventeenth century with special emphasis on Rome and Venice. The role of representative artists (Caravaggio, Bernini, Borromini, Pietro da Cortona, Artemisia Gentileschi, Elisabetta Sirani and Longhena) is emphasized. Prerequisite: 58.101 and/or 58.204, 58.321 or permission of instructor. Fall, alternate years, 3 cr.

58.334 Northern Baroque Art

The examination of seventeenth century painting outside Italy with emphasis on Dutch, Flemish, Spanish and French Art. The role of representative artists of the period (Rembrandt, Rubens, Vermeer, Velazquez, Leyster, Clara Peeters and Poussin) is emphasized. Prerequisite: 58.101 and/or 58.204, 58.323 or permission of instructor. Spring, alternate years, 3 cr.

58.340 Women and Art

Investigation of the various ways women have been portrayed in the visual arts from antiquity to the present. A chronological examination of selected female artists and their milieu from the Middle Ages to the twentieth century. Prerequisite: 58.101 and/or 58.203, 58.204 or permission of instructor. Fall, alternate years, 3 cr.

58.345 The Pre-Raphaelites

The examination of nineteenth century painting in England with a study on the role of representative artists such as Ford

Madox Brown, Dante Gabriel Rossetti, John Everett Millais, Edward Burne-Jones, William Holman Hunt, Elizabeth Siddall, Fredrick Sandys, and William Morris. Prerequisite: 58.101 and/or 58.204, 58.211 or permission of instructor. Fall, alternate years, 3 cr.

58.350 Post-Modernism in Art and Architecture

Following the Second World War, artists transformed the avant-garde tradition of their European predecessors to establish a dialogue with the mass media and consumer culture that has resulted in a wide array of artistic movements. Issues ranging from multiculturalism and gender to modernism and postmodernism will be addressed through the movements of abstract expressionism, pop, minimalism, neo-expressionism and appropriation in the diverse media of video, performance and photography, as well as painting, sculpture and architecture. Prerequisite: 58.221 or permission of instructor. Spring, alternate years, 3 cr.

58.352 Critical Issues: History of Art, Theory, and Criticism

Examination of issues of content, theory and criticism in traditional, modern and contemporary art. Current exhibitions and criticism are integral to the course. Topics vary from year to year. Prerequisite: 58.203, 58.204 and 58.350 or permission of instructor. Fall, alternate years, 3 cr.

58.360 Museum Issues

The art museum in the United States is a unique social institution because of its blend of public and private support and its intricate involvement with artists, art historians, collectors, the art market, and the government. This course will study the art museum's history and status in our society today. Special consideration will be given to financial, legal and ethical issues that face art museums in our time. Short papers, oral reports and visits with directors, curators and other museum officials in nearby museums will be included along with a detailed study of a topic of one's choice. Prerequisite: 58.203 and 58.204. Fall, alternate years, 3 cr.

58.370 Art History and Film

Examination of issues of content, theory and criticism in traditional, modern and contemporary live of artists, autobiogra-

phies, biographies and historiographies as source of filmic expression. Focus on the interpretation and transformation of art historical records into filmic vision as revealed in set and costume design, music, camera technique and other aesthetic elements of film, as well as how such elements function to extend and convey directorial vision to movements in art history. Prerequisite: 58.203 and 58.204 or permission of art history instructor. Fall, alternate years, 3 cr.

58.490 Art History Seminar

Study of particular artist, style or selected art historical problem. Topics to be announced. Course may be repeated. Prerequisite: permission of art history instructor. Fall and Spring 3 cr.

Directed Study

Directed study courses are available only to art history students and may be elected provided that (1) the material to be covered is not available in departmental course offerings, (2) art history instructor is willing to undertake a directed studies course, and (3) no more than six hours of credit in the major field is acquired through registration for a completion of directed studies courses.

58.494 Directed Study in Art History

An individual supervised research project relating to stylistic, thematic or methodological issues in Art History, the result to be presented in a significant paper. Prerequisite: permission of art history instructor. Fall and Spring 3 cr.

58.495 Advanced Tutorial in Art History

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate and investigate an additional problem. The purpose is to sharpen and refine skills for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of art history instructor. Fall and Spring 3 cr.

58.496 Practicum Experience in Art History

A program of on-campus and/or off-campus experiences for art history students only. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or credits. Students will be graded "satisfactory" or "unsatisfactory." Prerequisite: permission of the Art History Coordinator or supervising art history instructor.
Fall and Spring 3 cr.

Department of Biological Sciences

Robert D. Lynch, Chairperson

Professors: Susan J. Brauhn, Robert M. Coleman (Emeritus), David T. Eberiel, Jerome Hojnacki, Ethel Kamien (Emerita), Robert D. Lynch, John C. Mallett, Thaddeus V. Osmolski, Nicholas J. Rencricca (Emeritus), Ezequiel Rivera, Thomas B. Shea, Robert H. Tamarin

Associate Professors: Siu-Lam Lee, John F. Lyon (Emeritus), Ilze B. Skare

Assistant Professors: Garth F. Hall, Juliette Rooney-Varga, Prentiss Shepherd (Emeritus)

Department Location: Olsen Hall, Room 604

Telephone: (978) 934-2860

Biological Sciences Major

Students majoring in Biological Sciences prepare for a variety of careers which contribute to our understanding of basic life processes and the solution of problems related to health and the environment. Many of those graduating with their Bachelors degree are employed by institutions involved in bio-medical research or environmental field studies, while others become science educators. Degree recipients often choose to continue their education in professional (medical, veterinary, dental) schools or by matriculating into masters and doctoral programs. Since their training in science is integrated with an education in humanities and social sciences, graduates are not only prepared to excel in expanding the base of knowledge in their field of expertise, but are able to understand and respond to social and ethical issues arising from these advances.

The undergraduate program insures a strong foundation in supporting science and mathematics and provides the essential background needed for a career in modern biology. A variety of upper-level electives are available, and the curriculum is sufficiently flexible so that students may tailor it to meet their specific career goals and entrance requirements of professional schools and postgraduate programs. Although it is not required, quali-

fied seniors are encouraged to conduct original research as a capstone to their undergraduate experience. Enrolling in Senior Research provides graduation credits, but more importantly, many of these projects have resulted in a student's first publication in a professional journal or have been presented at scientific meetings.

Pre-Medical and other Pre-Professional Programs

Advisor: Dr. David Eberiel

Olsen 512A, Phone: 934-2866

E-mail: David_Eberiel@uml.edu

The curriculum in the Department of Biological Sciences prepares students for entry to schools of medicine, dentistry, veterinary medicine, osteopathic medicine, optometry, podiatry, and chiropractic. Interested students should meet, at their earliest convenience, with the University Pre-Health Professions Advisor, who along with a university wide committee, will assist them with course selection and guide them through the application process for admission to the professional school of their choice.

The Biotechnology Option

This option offers biology majors a set of advanced courses designed to provide the conceptual background and practical training needed for an exciting and lucrative careers in genetic engineering, industrial microbiology, cell culture technology, and the manufacture and purification of diagnostics and other biologically relevant materials. Students can integrate course offerings from the departments of Chemistry and Earth Sciences as well as Chemical, Plastics and Civil Engineering, into the design of their major program.

Many students in Biological Sciences take advantage of the unique resources of Research Centers affiliated with the Department of Biological Sciences. The Centers for Neurobiology and Bioprocess Development, offer courses and/or research opportunities to qualified undergraduates.

Opportunities in Environmental Biology

Students interested in environmental biology may pursue a degree in Biological

Sciences with a focus in environmental studies. This program enables students to obtain a foundation in biological sciences and to apply this knowledge to environmental topics. Interested students should meet with their faculty advisor to tailor a program appropriate to their needs and interests. In addition to courses that form the core curriculum of the Biological Sciences Major, students may elect courses such as Principles of Ecology, Invertebrate Zoology, Botany, Introduction to Marine Biology, Introduction to Insect Biology, Limnology, Wetlands Ecology, Environmental Soil Science, as well as Toxicology and Risk Assessment. They may also enroll in environmental science, economics, and law classes offered by other departments. Examples of relevant courses outside the field of Biology include Geographic Information Systems, Environmental Geochemistry, Atmospheric Dynamics, Air Pollution Phenomenology, Environmental Law, and Environmental and Natural Resource Economics. Opportunities are also available for a limited number of qualified seniors interested in conducting Senior Research projects in environmental biology.

Secondary Science Education

The flexibility of the curriculum in Biological Science allows students who are interested in secondary school teaching to participate in a five-year program leading to the master of education and Massachusetts teacher certification. Students achieve competency in all required subject areas during the four years that lead to the BS in Biological Science, then continue their studies in the College of Education for an additional year. A candidate successfully completing the program earns the graduate degree as well as the credentials to accept an appointment as a secondary school science teacher. For more details about the 'Fast Track To Education' please refer to the program described in the College of Education section of the Graduate School Catalogue.

The Honors Program

Students admitted to the Honors College, as well as those whose academic performance is consistently at a high level, are invited to enroll in special sections of required and elective courses. These sec-

tions promise an enhanced learning experience and/or an amplification of the subject matter presented in the regular sections. Modes of examination and course requirements may differ as well. The Department of Biological Sciences provides several Honors courses. Exceptional students may also avail themselves of "Honors Supplements" to many of the other departmental offerings. Honors students explore a subject in greater depth and/or breadth than in the standard course. Additional meetings with the instructor, augmented course assignments, an independent project, or a combination of these are usually required. Successful completion of such courses will earn honors credit and will be so designated on the University transcript.

Other Programs Supported by Biological Science

In addition to meeting the needs of students majoring in Biological Sciences, the Department offers courses to others who have elected the Biology focus in the Environmental Sciences program or who are pursuing a degree in biomedical aspects of Radiological Sciences. Specialized upper level courses are also available to qualified students majoring in other science, health, and engineering programs throughout the University.

Post-Graduate Programs in Biological Sciences

The following is a summary of post-graduate training available in the Department of Biological Sciences. For more detailed information, please consult the Graduate School Catalog or request specific information from the Department Office.

Graduate Certificate in Biotechnology and Bioprocessing

This certificate, offered jointly by the Departments of Biological Sciences and Chemical Engineering, will be of special interest for those seeking employment in the biotechnology industry. These multidisciplinary courses in fermentation, cell cultivation and protein purification bridge the gap between research and manufacturing, and add breadth to the students' background, preparing them for leadership

roles in biopharmaceutical project teams. Three of the four courses required for certification are offered by the Massachusetts Bioprocess Development Center. The fourth may be any of several approved biotechnology electives available within both departments. With careful planning, a student receiving the Bachelor's degree in Biology or Chemical Engineering may complete requirements for the Graduate Certificate on a full or part time basis during the summer and fall semesters following graduation. Note that credits earned for the certificate can be applied toward the total credits (30) needed to satisfy requirements for the M.S. degree in Biological Sciences.

Five Year B.S./M.S. Program

An accelerated five-year course of study leading to the B.S. and M.S. degrees in Biological Sciences is available. Interested students, after evaluation and acceptance by the Department's graduate selection committee, are assigned an advisor to assist them in designing a plan for completion of requirements for both degrees within a five-year time frame. It should be noted that credit received for courses taken to complete requirements for the Graduate Certificate in Biotechnology and Bioprocessing can be applied toward the total credits needed to complete the Five Year B.S./M.S. Program.

M.S. and Doctoral Programs

The objective of these programs is to foster critical thinking and to develop skills needed for independent laboratory study. This is accomplished, in part, by offering advanced lecture, seminar and laboratory courses. While it is possible to complete M.S. requirements without thesis or project option it is this latter activity that most distinguishes graduate from undergraduate students. All full-time M.S. degree students are, therefore, strongly urged to elect thesis or project options. The Department of Biological Sciences also collaborates with the Department of Chemistry in offering the Ph.D. Option in Biochemistry. Laboratory thesis research is a required component of this program.

Research in the Department of Biological Sciences

Eligible undergraduate and graduate students interested in research are encouraged to meet with research faculty as early in their program as possible in order to identify topic areas of interest. The principal areas of research in this department are in molecular and cell biology, biotechnology, biochemistry and environmental biology. In addition to research programs within the Department, there are interesting projects on-going in the Massachusetts Bioprocess Development Center. Since there is a limit to the number of students who can be accommodated by any professor, it is a good idea, to select a number of projects so that, if one laboratory is filled, there are alternatives. There is no guarantee that all students seeking laboratory research experience will be accommodated.

Degree Requirements (Biological Sciences)**I. General Education Guidelines (24 credits)**

Students must conform to the General Education guidelines as outlined elsewhere in this document. These include one year of College Writing and the distribution of six additional electives among behavioral and social science (two courses), aesthetics, historical studies, literature, and human values (one course each).

II. Major Field Requirements**A Designated Biological Sciences 31 cr**

81.111	Principles of Biology I	3 cr
81.113	Principles of Biology I Lab	2 cr
81.115	Freshman Seminar	1 cr
81.112	Principles of Biology II	3 cr
81.114	Principles of Biology II Lab	2 cr
81.116	Freshman Seminar	1 cr
81.201	General Microbiology	3 cr
81.203	General Microbiology Lab	1 cr
81.252	Physiology	4 c
81.335	Principles of Genetics	3 cr
81.337	Experimental Genetics	1 cr
81.419	Biochemistry	3 cr

81.421	Techniques in Biochemistry	2 cr
81.451	Senior Sem in Adv Topics I	1 cr
81.452	Senior Sem in Adv Topics II	1 cr

B. Supporting Sciences & Math 35 cr

84.121	Chemistry I	3 cr
84.123	Chemistry I Lab	1 cr
84.122	Chemistry II	3 cr
84.124	Chemistry II Lab	1 cr
84.221	Organic Chemistry IA	3 cr
84.229	Organic Chemistry Lab IA	1 cr
84.222	Organic Chemistry IIA	3 cr
84.230	Organic Chemistry Lab IIA	1 cr
92.131	Calculus I or	4 c
92.127*	Calculus IA and	4 cr
92.128*	Calculus IB	4 cr
92.183	Intro to Stats (or substitute)	3 cr
95.201	Principles of Physics I (or substitute)	3 cr
95.202	Principles of Physics II (or substitute)	3 cr
96.103	Gen Experimental Physics I	1 cr
96.104	Gen Experimental Physics II	1 cr

*Calculus IA & IB, combined, earn only 4 credits for graduation.

III. Option Requirements**A. Biology Option 14 cr**

Two semesters of senior research or two full-time upper level biology courses with a laboratory component, as well as two additional full-time upper level courses.

Electives (free + designated) excluding courses with an "83" prefix and mathematics courses below the level of Calculus I. 14-18 cr

B. Biotechnology Option (20 credits minimum)

Required Upper Level Courses		14 cr
81.467	Recombinant DNA Tech	3 cr
81.469	Recombinant DNA Tech Lab	2 cr
81.476	Cell Culture	2 cr
81.478	Cell Culture Laboratory	2 cr

81.493	Immunology	3 cr
81.495	Immunology Laboratory	2 cr
Designated Biotechnology Electives		6 cr

A minimum of two courses must be selected from an approved list that include:

81.420	Biochemistry 11	3 cr
81.535	Cell & Microbe Cultivation*	3 cr
81.545	Isolation & Purification	
Biotech Products*		3 cr
81.586	Biotechnology Processing	
Projects Lab*		3 cr
81.558	Industrial Microbiology	3 cr
81.472	Virology	3 cr
81.474	Virology Laboratory	2 cr
81.442	Cell Biology	3 cr
81.563	Electron Microscopy	4 cr
84.339	Physical Chem Principles	3 cr
84.341	Physical Chem Princ Lab	1 cr
84.313	Analytical Chemistry I	3 cr
84.315	Analytical Chemistry I Lab	1 cr
84.314	Analytical Chemistry II	3 cr
84.316	Analytical Chemistry II Lab	1 cr
84.526	Theory & Practice of	
Chromatography		3 cr

*Open to seniors with permission of instructor.

IV. Additional Courses (0-12 credits)

A minimum of 120 credits is required for the Bachelor's Degree. Free electives may be selected from the offerings of any department of the University with the exception of Mathematics courses below the level of Calculus IA and courses designated by the Department of Biological Sciences for non-majors all of which have an "83" prefix.

As part of the 120 credits required for graduation, all students in Bachelor of Science programs must earn at least 74 credits in a minimum of 20 courses offered by the College of Arts and Sciences.

Biological Sciences Minor

A minor in Biological Sciences consists of the following:

1. Two semesters of college-level introductory biology with a laboratory component. This requirement may be satisfied by electing the lecture and laboratory sections in either the Principles of Biology or Life Science courses.

2. Four additional three- or four-credit courses with an "81" prefix offered by the Department of Biological Sciences. Two of these courses must have a laboratory component. At least six credits must be at the 300 level or above.

Sample Course of Study

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

81.111	Principles of Biology I	3
81.113	Principles of Biology Lab I	2
81.115	Freshman Seminar in Biology I	1
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
42.101	College Writing I (Gen Ed)	3
		13

Spring Semester

81.112	Principles of Biology II	3
81.114	Principles of Bio Lab II	2
81.116	Freshman Seminar in Biology II	1
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.131	Calculus I	4
42.102	College Writing II (Gen Ed)	3
		17

Sophomore Year**Fall Semester**

81.201	General Microbiology	3
84.203	General Microbiology Lab	1
84.221	Organic Chemistry I-A	3
84.229	Organic Chemistry I-A Lab	1

92.132	Calculus II	4
	Beh & Soc St (Gen Ed)	3
		15

Spring Semester

81.252	Physiology	4
84.222	Organic Chemistry II-A	3
84.230	Org Chemistry II-A Lab	1
	Statistics Elective	3
	Beh & Soc St (Gen Ed)	3
		14

Junior Year**Fall Semester**

81.419	Biochemistry	3
81.335	Principles of Genetics	3
81.337	Experimental Genetics	1
	College Level Physics I	3
	College Level Physics Lab I	1
	Historical Studies (Gen Ed)	3
		14

Spring Semester

81.421	Tech in Biochemistry	2
	College Level Physics II 3	3
	College Level Physics Lab II 1	
81.3/4	Biology Elective	3
	Literature (Gen Ed)	3
	Free Elective	3
		15

Senior Year**Fall Semester**

81.451	Sr Seminar in Adv Topics	1
81.411	Senior Research or	
81.3/4	Biology Elective w/Lab	4
81.3/4	Biology Elective	3
	Free Elective	3
		14

Spring Semester

81.452	Sr Sem in Adv Topics	1
81.412	Senior Research or	
81.3/4	Biology Elective w/Lab	4
81.3/4	Biology Elective	3
	Aesthetics (Gen Ed)	3
		11

Sample Course of Study**Biotechnology Option**

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

81.111	Principles of Biology I	3
81.113	Principles of Biology I Lab	2
81.115	Freshman Bio Seminar	1
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
42.101	College Writing I (Gen Ed)	3
		13

Spring Semester

81.112	Principles of Biology II	3
81.114	Principles of Biology II Lab	2
81.116	Freshman Bio Seminar	1
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.131	Calculus I	4
42.102	College Writing II (Gen Ed)	3
		17

Sophomore Year**Fall Semester**

81.201	General Microbiology	3
81.203	General Microbiology Lab	1
84.221	Organic Chemistry I-A	3
84.229	Organic Chemistry I-A Lab	1
92.132	Calculus II	3
	Beh & Soc St (Gen Ed)	3
		14

Spring Semester

81.252	Physiology	4
84.222	Organic Chemistry 11-A	3
84.230	Organic Chemistry 11-A Lab I	
	Statistics Elective	3
	Beh & Soc St (Gen Ed)	3
		13

Junior Year**Fall Semester**

81.419	Biochemistry	3
81.335	Prin of Genetics	3

81.337	Experimental Genetics	1
	College Level Physics 1	3
	College Level Physics Lab 1	1
	Historical Studies (Gen Ed)	3
		14

Spring Semester

81.421	Techniques in Biochemistry	2
81.476	Cell Culture	2
81.478	Cell Culture Lab	2
	College Level Physics 11	3
	College Level Physics Lab 111	
81.	Biotechnology Elective	3
	Literature (Gen Ed)	3
		16

Senior Year**Fall Semester**

81.451	Sr Seminar in Adv Topics	1
81.495	Immunology Lab	2
81.467	Recombinant DNA	3
81.469	Recombinant DNA Lab	2
81.	Biotechnology Elective	3
	Values, C & C (Gen Ed)	3
		14

Spring Semester

81.452	Sr Seminar in Adv Topic I	
81.	Biotechnology Elective	4
81.	Biotechnology Elective	4
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Biology Courses (Prefix: 81)

Courses designed primarily to satisfy the requirements of students majoring or minoring in Biological Sciences; they may also serve as electives for others with specialized interests.

81.111 Principles of Biology I

Designed for students intending to pursue careers in the biological sciences, biotechnology or related areas such as medicine, biomedical research, radiological sciences or environmental sciences. This is the first course of a two semester sequence which introduces such topics as the chemical

and physical basis of life, its evolution, diversity and distribution, as well as the interrelationships between life forms. The central theme of gene replication, translation, expression and selection will be emphasized as a unifying principle which determines and integrates structure and function at the cell, individual, population and community levels of organization. Corequisite: 81.115 I(3,0)3

81.112 Principles of Biology II

A continuation of the 81.111 in which students are introduced to such topics as molecular energy exchange in organisms (photosynthesis and respiratory metabolism). The common functional needs of support, locomotion, nutrition, internal communication and the maintenance of homeostasis are considered. Control and regulation of organisms at levels beyond the individual are considered through discussions of population and community ecology. Corequisite: 81.116 II(3,0)3

81.113 Principles of Biology I Laboratory

A series of field trips and laboratory exercises designed to introduce the student to concepts of the distribution and maintenance of life. Specific consideration is given to the diversity and organization of local ecosystems; the continuation of life is considered through exercises covering mitosis, meiosis, genetics and evolutionary biology. A weekly one-hour pre-laboratory recitation is an integral component of the course. I(1,3)2

81.114 Principles of Biology II Laboratory

A series of laboratory experiments, analyses and exercises designed to introduce students to biological techniques and processes at the subcellular, cellular and organ systems levels. A weekly one-hour prelaboratory recitation is an integral component of the course. II(1,3)2

81.115, 81.116 Freshman Seminar in Biology (Honors section available)

This course offers a small group seminar format for problem solving and discussion with faculty and staff. It is designed for individual participation in exploring concepts related to material considered in Principles of Biology I and II (81.111 and 81.112). Required of freshman students; optional, with permission of instructor, to others registered in lecture section. Corequisite: 81.111 or 81.112 I,II(1,0)1

81.201 General Microbiology (Honors section available)

A study of the general properties of bacteria and viruses (anatomy, physiology, genetics, metabolism, cultivation, and growth); discussions include major microbial infections in man (etiologic agent, antibiotics and chemotherapy) and an examination of the role of the microbes in the environment. Prerequisites: 84.122, 81.111 and 81.112. Corequisite: 81.203 I(3,0)3

81.203 General Microbiology Laboratory

A series of laboratory exercises covering basic qualitative and quantitative techniques commonly employed in a microbiology laboratory. Corequisite: 81.201 I(0,3)1

81.215 Introduction to Marine Biology

An introduction to the marine environment with major consideration given to the biological and ecological aspects. Emphasis is on the flora and fauna of New England. Several field trips are required. Corequisite: 81.217 (2,0)2

81.217 Intro to Marine Biology Laboratory

A series of laboratory exercises and field trips designed to emphasize the material covered in 81.215 (0,3)1

81.224 Intro to Insect Biology

A survey of the major groups of insects. Topics include their structures, importance, and relationship to man. Prerequisites: 81.111, 81.112 or Life Science Corequisite: 81.226 (2,0)2

81.226 Intro to Insect Biology Laboratory

A series of laboratory studies on the structures, diversity, and collection techniques of insects. Corequisite: 81.224 (0,2)1

81.252 Physiology

A series of lectures, laboratory exercises and/or library projects which introduce students to the fundamental mechanisms governing mammalian physiology. The role of cell physiology in determining systemic functions and coordinating biological control systems will be emphasized. Maintenance of homeostasis will be discussed in terms of biochemical, cytological, anatomical and physical principles. II(3,3)4

81.306 Invertebrate Zoology

A survey of the phyla of invertebrate animals. Discussions include their physiology, development, morphology, behavior, ecology and adaptations. Corequisite: 81.308 (3,0)3

81.308 Invertebrate Zoology Laboratory

A broad spectrum of living and preserved specimens are studied in the laboratory with regard to both structure and function. Corequisite 81.306 (0,3)1

81.315 Principles of Ecology

A series of lectures concerned with the interrelationships of organisms with their abiotic environment with emphasis on the New England area. Selected current topics will supplement the text. Prerequisites: 81.111, 81.112, 81.113 and 81.114 Corequisite: 81.317 I(3,0)3

81.317 Principles of Ecology Laboratory

A series of laboratory exercises to supplement and illustrate lectures of 81.315. Field trips are an integral part of the course involving sampling and analysis of such ecosystem components as water, soil, invertebrate fauna and characteristic flora of various habitats. Directed readings, quizzes, practical exam and oral presentation of a research topic are integral parts of the course. Corequisite: 81.315 I(0,4)2

81.320 Botany

An introduction to the study of the plant kingdom dealing with the structure, function and diversity of plants with an emphasis on seed plants. The physiology, morphology, and taxonomy of plants is emphasized. Corequisite: 81.322 (3,0)3

81.322 Botany Laboratory

Field and laboratory exercises designed to emphasize material covered in 81.320. Corequisite: 81.320 (0,3)1

81.327 Histology

An introduction to the microscopic structure of animal tissues with emphasis upon human histology. Laboratory investigation is an integral part of the course. Prerequisites: 81.111, 81.112, 81.113 and 81.114 Corequisite: 81.329 (3,0)3

81.329 Histology Laboratory

A series of laboratory exercises designed to emphasize the material covered in 81.327 Corequisite: 81.327 (0,3)1

81.335 Principles of Genetics

The theories of both classical and molecular genetics are explored with emphasis on the experimental evidence which has laid the foundation for contemporary understanding of genetics. Included is the nature of the genetic material, gene action, genetic recombination, gene regulation, gene interaction, the production and inheritance of genetic phenotypes, chromosomal mechanics, and the behavior of genes in populations. Prerequisites: 81.111, 81.112, and 84.222, Corequisite: 81.337 I(3,0)3

81.337 Experimental Genetics

Techniques of genetic analysis using molecular, prokaryotic and eukaryotic systems. There is an emphasis on problem solving and statistical methods Corequisite 81.335 I(0,3)1

81.342 Comparative Vertebrate Anatomy

A study of the basic similarities and differences of organ systems in the vertebrates with reference to the fields of embryology, histology, and paleontology. Representative vertebrates are studied in the laboratory. Prerequisites: 81.111, 81.112, 81.113, and 81.114 Corequisite: 81.344 (3,0)3

81.344 Comparative Vertebrate Anatomy Laboratory

A series of exercises designed to emphasize the material covered in 81.342. Corequisite: 81.342 (0,4)2

81.347 Human Nutrition

Emphasizes fundamental physiological and biochemical principles of human nutrition. A basic course in physiology is a prerequisite. Students will have an opportunity to compare their present dietary practices with recommended dietary allowances, goals and guidelines. Nutrient excesses and inadequacies during various stages of the life cycle (pregnancy, infancy, childhood, adolescence, adulthood, old age) will be considered. Current concepts and controversies in nutrition research, surveys, and methods will also be evaluated. (3,0)3

81.401,402 Supervised Teaching in Biology I, II

Through observation, preparation of material and presentation of demonstrations in selected courses offered by the Department of Biological Sciences, the

student becomes familiar with the materials and teaching/learning situations in biology. I,II(0,3)1

81.404. Environmental Microbiology (Honors section available)

Examination of microbial communities in natural and artificial environments and interactions between microorganisms and their abiotic environments. Consideration is given to the role of microorganisms in the flux of energy and matter through ecosystems at molecular, ecosystem, and global scales; microbial consortia and symbioses; and modern techniques in environmental microbiology. Prerequisite: 81.201. II(3,0)3

81.411,412 Senior Research in Biology

An individual, directed one-year research program for senior biology majors selected on the basis of previous academic performance at the end of the junior year. A topic will be chosen after consultation with a faculty member. A report of the research in the form of a thesis is required. Students may not receive credit for either 81.411 or 81.412 alone. I, II(0,12)4

81.419 Principles of Biochemistry I (Honors section available)

A study of the structure and properties of proteins, carbohydrates, and lipids which, combined with a discussion of elementary enzymology, allows for detailed descriptions of several important degradative and biosynthetic pathways, their integration and regulation. Throughout the course, emphasis is on methods and practical application of fundamental information to the solution of problems of current biomedical interest. Prerequisite: 84.221 Recommended: 84.344 I(4,0)3

81.420 Principles of Biochemistry II

A continuation of 81.419 which will include the following topics: a) biosynthesis and degradation of amino acids, purine and pyrimidine nucleotides, and regulation of these metabolic pathways, b) structure and function of chromatin DNA and RNA, and c) mechanism of DNA, RNA, c) mechanism of DNA, RNA and protein biosynthesis and regulation of gene expression. Prerequisite: 81.419 II(3,0)3

81.421 Techniques of Biochemistry

A series of discussions and "hands on" laboratory exercises emphasizing techniques and use of equipment most commonly

employed in biochemical-biomedical research laboratories. Techniques to be mastered include: cell culture, cell fractionation, enzyme purification, ultracentrifugation, UV-visible spectrophotometry, spectrofluorometry, various types of chromatography (thin layer, gas, gel exclusion, ion exchange), electrophoresis, liquid scintillation spectrometry, and the safe handling and application of radioisotopes to problems in biochemistry. Wherever possible, the principles presented in 81.419 will be used as a basis for experimentation using the above techniques. Prerequisite: 81.419 or the equivalent II(1,4)2

81.435 Population Genetics and Evolution

An examination of current theories of the evolution of life and the evidence supporting these theories. Discussions focus on how genetic mechanisms and biological processes might account for diversity of life forms.

81.442 Cell Biology

Deals with the study of the cell and its cytoplasm incorporating the structure of cell membranes and the organelles they define; specialized organelles dealing with energy capture and transduction, some aspects of histochemical and biochemical studies on cytoplasmic organelles at the electron microscopic level. An introduction into cytogenetics and nuclear cytology; a brief discussion of prokaryotic cells. Prerequisites: 81.419 and permission of instructor. Corequisite: 81.444 (3,0)3

81.444 Cell Biology Laboratory

Introduction to the optical microscope as an analytical tool. Individual laboratories using a variety of instruments designed to acquaint the student with the analysis of cells. Analysis of biological ultrastructure at the optical and electron microscopic level. Corequisite: 81.442 (0,3)1

81.451,452 Senior Seminar in Advanced Topics

Seminar discussion of selected topics of current research interest. An oral seminar presentation as well as a written report are required of all biology seniors. I,II(1,0)1

81.467 Recombinant DNA Techniques

A study of the principles and specialized techniques of cloning, purifying, and manipulating recombinant DNA molecules. Prerequisites: 81.335, 81.419, and

permission of instructor Corequisite: 81.469 I(3,0)3

81.469 Recombinant DNA Techniques Laboratory

Laboratory experiments and independent projects designed to illustrate current techniques and instrumentation used in genetic engineering. Included are restriction mapping, cloning, plasmid purification, blot hybridization, PCR, and DNA sequencing. Students are introduced to computer software utilized for DNA sequence analysis and manipulation. Corequisite: 81.467 II(1,4)2

81.472 Virology

A study of bacterial, animal, and plant viruses, including viral structure, modes of replication, biochemistry of the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interaction at the molecular level. Prerequisites: 81.335 and 81.419 II(3,0)3

81.474 Virology Laboratory

Experiments with bacterial and animal viruses including lytic virus propagation and titring, biochemical, biophysical, and genetic analysis of viral nucleic acids and proteins, and cell culture techniques. Pre requisite/corequisite: 81.472 II(0,4)2

81.476 Cell Culture

Lectures and readings on the biology and culture of animal and plant cells in vitro. Students are introduced to methodologies utilized in employed biomedical research laboratories as well as the biotechnology industry. Prerequisite: 81.335, 81.419 (and 81.493 or permission of instructor) Corequisite: 81.478 II(2,0)2

81.478 Cell Culture Laboratory

A series of exercises demonstrating the principles presented in 81.476. Techniques will include: media preparation, standard culture procedures. Corequisite: 81.476 II(0,4)2

81.491,492 Senior Project in Biology

Individual, directed one semester research project taken in the fall and/or spring. Presentation of an acceptable project plan at the time of registration is required. A project report is required. I,II(0,12)4

81.493 Immunology

A study of the nature of the immune response with sections on antibody structure, function and production; antigen-antibody reactions; immunogenetics; and

immune regulation, protection and injury. Prerequisites: 81.335 and 81.419 I(3,0)3

81.495 Immunology Laboratory

A series of basic laboratory exercises dealing with the preparation, isolation and characterization of antigens, antibodies and effector cells. I(1,4)2

81.496 Practicum Experience

On-campus and/or off-campus experiences are developed by the student in consultation with a member of the student's major department. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a scientific area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of department chairperson. I,II(0,9)3

Graduate Biology Courses

The following 500-level courses are primarily for graduate students, but are open to qualifying undergraduate students with instructor's permission.

81.500 Professional Internship

Credits will be given to individuals who present evidence of having at least one full year of experience in an academic, hospital, or industrial laboratory setting, or in secondary school science teaching. I,II(3,0)3

81.501,502 Selected Topics in Biology

Current topics in various fields of biology presented in lecture, seminar or discussion groups. Subject matter may vary depending on interests of instructor and needs of students. May be repeated for credit when course content differs. I,II(3,0)3

81.504. Environmental Microbiology

Topics covered are similar to those considered in 81.404. However, students are required to complete a more in-depth review of a current research topic in environmental microbiology.

81.510 Limnology

Introduction to freshwater environment considering geology, chemistry and

physics of waters as they affect flora and fauna in standing and flowing water. Attention is addressed to basin and channel morphometry, thermal, photic, hydrologic and solvent properties of the medium. Prerequisites: 81.111, 81.112 and Ecology (3,0)3

81.525 Neurobiology

Textbook readings of advanced neuronal cell biology topics are expanded upon by discussion of current journal publications, and guest lectures by internationally recognized neuroscientists. Topics include aspects of signal transduction, cytoskeletal assembly, development of polarity, cell signaling, and development. The relationship between errors in these processes and the events leading to several human neurodegenerative conditions is explored. In addition to gaining expertise in contemporary neurobiology, students learn how to critically analyze current hypotheses and research methodologies as published in leading journals. 1,(3,0)3

81.535 Principles of Cell and Microbe Cultivation

Cultivation of recombinant and non-recombinant mammalian cells and microorganisms. Prerequisite: Senior status in biology, chemistry or chemical engineering and permission of instructor. (3,0)3

81.541 Advanced Topics in Cell Biology and Physiology

Structure and function of the cell: a) cellular membranes, b) transport mechanisms, c) motility, d) excitable cells, and e) energy transduction mechanisms. May be repeated for credit when content varies. Prerequisite: 81.419 (3,0)3

81.542 Cell Biology

Ultrastructure and biochemistry of eukaryotic cells; cell membranes and organelles; energy capture and transduction; histochemical and biochemical studies of organelles at the optical and electron microscopic level; cytogenetics; brief discussion of prokaryotic cells. A substantial library investigation is required. Prerequisite: 81.419 or equivalent. Corequisite: 81.544 (3,0)3

81.544 Cell Biology Laboratory

The use of the optical microscope as an analytical tool. Analysis of biological ultrastructure at the optical and electron microscopic level. Cell fractionation.

Chromosome preparations. One substantial ultrastructural analysis required. Corequisite: 81.542 (0,3)1

81.545 Isolation and Purification of Biotech Products

Efficient isolation and purification of biological products, especially proteins, from complex natural mixtures. Prerequisite: Senior status in biology, chemistry or chemical engineering and permission of instructor. (3,0)2

81.548 Principles of Biochemistry I

Primarily for M.S. students in biological sciences. Lecture and text assignments on the subjects of protein, carbohydrate, lipid, enzyme and membrane biochemistry will be supplemented with research journal readings. Prerequisite: 84.222 Recommended: 84.344 I(4,0)3

81.549 Principles of Biochemistry II

This course is a continuation of 81.519 and will include discussions on all aspects of amino acid and nucleic acid metabolism and protein biosynthesis. 11(3,0)3

81.554 Techniques in Biochemistry

Emphasis on common techniques and instrumentation employed in modern research laboratories. Pre requisite/corequisite: 81.419 or equivalent Required of M.S. students in the Biotechnology Option II(1,4)2

81.558 Industrial Microbiology

Selected topics concerned with the use of microorganisms for the production of substances of economic importance. The principles and techniques of fermentation to produce such products as amino acids, antibiotics, vitamins, and organic acids are addressed with emphasis on metabolic regulation of biochemical pathways and genetics of industrially important microorganisms. Prerequisite: 81.419 or equivalent II(3,0)3

81.563 Electron Microscopy

Theory and Practice Introduction to electron optics and electron microscopes. Preparation of biological samples for electron microscopy. Operation of electron microscopes. Project required of all students. Prerequisites: 81.419 or equivalent, and permission of instructor (2,6)4

81.567 Recombinant DNA Techniques

A study of the principles and specialized techniques of cloning, purifying, and

manipulating recombinant DNA molecules. A term paper or seminar may be required. Prerequisites: 81.335, 81.419 and permission of instructor. Corequisite: 81.569 I(3,0)3

81.569 Recombinant DNA Techniques Laboratory

Laboratory experiments and independent projects designed to illustrate current techniques and instrumentation used in genetic engineering. Included are restriction mapping, cloning, plasmid purification, blot hybridization, and DNA sequencing. Students are introduced to computer software utilized for DNA sequence analysis and manipulation. Corequisite: 81.567 I(1,4)2

81.572 Virology

A study of bacterial, animal, and plant viruses, including viral structure, modes of replication, biochemistry of the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interaction at the molecular level. II(3,0)3

81.574 Virology Laboratory

Experiments with bacterial and animal viruses include lytic virus propagation and titering; biochemical, biophysical, and genetic analysis of viral nucleic acids and proteins; and cell culture techniques. II(0,4)2

81.576 Cell Culture

Lectures and readings on the biology and culture of animal and plant cells in vitro. Students are introduced to methodologies employed in basic biomedical research laboratories as well as the biotechnology industry. A term paper or seminar is required. Prerequisites: 81.335, 81.419 and 81.493 Corequisite: 81.578 II(2,0)2

81.578 Cell Culture Laboratory

A series of exercises demonstrating the principles presented in 81.576. Techniques will include: media preparation, and standard culture procedures, and hybridoma methodology. Corequisite: 81.576 II(1,4)2

81.580 Developmental Biology

An in depth discussion of contemporary topics related to reproduction and embryogenesis. Lecture material is supplemented with reading assignments in a recently published text book and current literature taken from research journals. Emphasis is on the dynamic nature of the interactions between developing cells as

well as the events that occur during fertilization, implantation and the development of the mammalian embryo which lead to birth. Students examine how studies with nonmammalian model systems such as *Drosophila* and *Xenopus* have enhanced our knowledge of mammalian development. Among the topics discussed are the role of adhesion molecules, HOX genes, apoptosis, hypomethylation of genes, axis formation and hormonal control of differentiation. Class participation is expected. Critical scientific reading and thinking is encouraged by having students present to the class published original research papers on topics of current interest in the field of developmental biology. II(3,0)3

81.586 Biotechnology Processing Projects Laboratory

Design and development of manufacturing processes for the products of biotechnology, with emphasis on techniques for the cultivation of cells, recovery and purification of cell products and analytical methods for the quantification of product yields. Prerequisite: Senior status in biology, chemistry, chemical engineering and permission of instructor (1,3)3

81.593 Immunology

A study dealing with the nature of the immune response with sections on antibody structure, function and production; antigen-antibody reactions; immunogenetics; and immune regulation, protection and injury. I(3,0)3

81.595 Immunology Laboratory

A series of basic laboratory exercises dealing with the preparation, isolation and characterization of antigens, antibodies and effector cells. Semester project required. I(1,4)2

Interdisciplinary Biology Courses (Prefix: 82)

Courses of an interdisciplinary nature exploring areas resulting from the interaction of biological science with other fields - academic, professional, or practical. These courses cannot be used as 81 electives in the biology program.

82.202 Heredity and Society

Lectures and readings dealing with the genetic aspects of social problems emphasize that the borderline between genetics and medicine, ethics, politics, sociology,

psychology, and agriculture are fertile areas for the development of new concepts. Successful completion of the course enables the student to offer informed opinions each time the genetic basis of social predicaments is introduced into the arena of public affairs and to correct many misconceptions in the public mind. (3,0)3

Life Science Courses (Prefix: 83)

Courses designed primarily to serve the needs of students who are not majoring or minoring in Biological Science. Although these courses may not ordinarily be used for degree credit for students majoring in Biological Sciences, they may be used as electives for others and may be used to satisfy University core requirements.

83.101 Life Science I

An examination of living systems from DNA to the biosphere. Emphasis is on cell structure and function, genetics, ecology and evolution. Corequisite: 83.103 I,II(3,0)3

83.102 Life Science II

Emphasis in this course is on human systems physiology. Topics include: nutrition and digestion, circulation, respiration, excretion, and nervous system functions. Also considered are the chemical interactions of these systems with immunity, hormonal and reproductive processes. Corequisite: 83.103 I,II(3,0)3

83.103 Life Science I Laboratory

Concerned with experimentation and interpretation of some of the concepts of Life Science I. Corequisite: 83.101 I,II(0,2)1

83.104 Life Science II Laboratory

Involved with experimentation and interpretation of some of the concepts of Life Science II. Corequisite: 83.102 I,II(0,2)1

83.123 Nutrition and Disease

An interdisciplinary, survey course for students not majoring in Biology which deals with human nutrition as it relates to various chronic disease states. Methods of detection and treatment of the disorders will be considered as well as general concepts of health promotion/disease prevention. Specific topics covered include the role of nutrition in: heart disease, diabetes, alcoholism, obesity, senility-geri-

atrics, gallbladder disease, cancer, anorexia nervosa-bulimia, and pregnancy. Parenteral nutrition will also be discussed. (3,0)3

Department of Chemistry

Edwin Jahngen, Chairperson

Eugene Barry, Graduate Coordinator

Philip Lamprey, Undergraduate Coordinator

Professors: William Bannister (Emeritus), Eugene Barry, Alexandre Blumstein (Emeritus), Rita Blumstein (Emerita), Rudolph Faust, Stanley Israel (Emeritus), Edwin Jahngen, Ernest James (Emeritus), Judith Kelley, Albert Kowalak, Philip Lamprey, Kenneth Marx, Melisenda McDonald, James Pierce (Emeritus), Harry Rubinstein (Emeritus), David Ryan, Daniel Sandman, Joseph Salamone (Emeritus), Samuel Sawan, Ruth Tanner, Sukant Tripathy, Arthur Watterson

Associate Professors: Nancy DeLuca, Martin Isaks, Kuang-Pang Li, Irving Lipschitz

Assistant Professors: Anastasios Angelopoulos, James Whitten

Department Location: Olney Hall, Room 520

Telephone: (978) 934-3650

Chemistry Major

Undergraduate offerings of the Chemistry Department solidly prepare students for continuing work in chemistry, as well as provide students a general background in the understanding of the natures of materials both natural and man made that are common to the modern world. Career opportunities in chemistry are many and varied, including, for example, applied and basic research, quality control, product analysis, manufacturing, and marketing. The B.S. degree in Chemistry is both a professional and a pre-graduate school degree. Completion of the chemistry curriculum provides a preparation for all areas of the chemical profession, as well as for graduate study in chemistry, dentistry, medicine, patent law, and teaching. Students completing the B.S. requirements graduate with a degree certified as being in a program approved by the Committee on Professional Training of the American Chemical Society.

Cooperative Education Program

The Chemistry Department has established guidelines for a cooperative program designed to combine chemistry oriented work experience in industrial or related laboratories with opportunities to earn an income. A student may enter this program after completing four semesters of academic work which must include the successful completion of one year of organic chemistry. Up to six academic credits will be allowed for the program which will include one summer and two academic terms of co-op work. A student applies for the program by signing a contract outlining the proposed co-op experience and requirements.

Financial Support and Awards

The Chemistry Department has a number of scholarships available. The Allen Scattergood Scholarships are awarded for superior academic achievement, requiring a minimum academic cumulative average of 3.500. Other scholarships are available based on financial need and academic record. Information regarding these can be obtained at the chemistry office or from the faculty member serving as Chairperson of the Scholarship and Awards Committee. The Department also has a number of annual awards for academic achievement, determined by the faculty and announced each spring.

Degree Requirements

I. University General Education Requirements (36-38 credits)

42.101	College Writing I	3 cr
42.102	College Writing II	3 cr
	Arts and Humanities	
	3 courses from an approved list	
	Social Sciences	
	3 courses from an approved list	
	Mathematics	
	1 course	
	Science and Technology	
	3 courses from an approved list with 2 containing experimental learning experiences	

Note: The mathematics and Sciences and Technology courses will be covered by required courses in the chemistry curriculum.

II. Major Field Requirements

A.	Chemistry	59-60cr
84.121	Chem I	3 cr
84.123	Chem I Lab	1 cr
84.122	Chem II	3 cr
84.124	Chem II Lab	1 cr
84.207	Inorganic Chem	3 cr
84.209	Inorganic Chem Lab	2 cr
84.221	Organic Chem I	3 cr
84.227	Organic Chem Lab I	2 cr
84.222	Organic Chem II	3 cr
84.228	Org Chem Lab II	2 cr
84.260	Info Retrieval	1 cr
84.313	Analytical Chem I	3 cr
84.315	Analytical Chem I Lab	2 cr
84.314	Analytical Chem II	3 cr
84.316	Analytical Chem II Lab	2 cr
84.334	Inorganic Chemistry II	3 cr
84.344	Physical Chem I	3 cr
84.345	Physical Chem II	3 cr
84.346	Physical Chem I Lab	2 cr
84.350	Phys Bioinorganic Chem Lab	2 cr
84.360	The Responsible Chemist*	3 cr
84.419	Biochemistry (Introduction to)	3 cr
	Chem Elective with Lab**	3 or 4 cr
	Chem Elective**	3 cr
*satisfies core requirement in Values, Concepts and Choice		
**Chem electives must be advanced courses with basic course prerequisites including Physical Chem I and II		
B.	Supporting Science & Math	26 cr
95.101	Principles of Physics I	3 cr
96.103	Gen Exp Physics I	1 cr
95.202	Principles of Physics II	3 cr
96.104	Gen Exp Physics II	1 cr
92.111	Everyday Computing	3 cr
92.131	Calculus I or	4 cr
92.127	Calculus IA and	4 cr
92.128	Calculus IB	4 cr
92.132	Calculus II	4 cr
92.231	Calculus III	4 cr

92.234 Differential Equations 3 cr

Note: Only 4 of the 8 credits for Calculus IA and Calculus IB can be counted toward the total credits needed for graduation.

C. Foreign Language

Chemistry majors are encouraged to take two semesters of or earn six credit hours for a foreign language at the introductory or intermediate level, or one semester (three credit hours) of a foreign language at an advanced level.

III. Program Options and Electives

Since the Bachelor of Science degree is meant to provide a broad educational experience as well as specialized training in chemistry, a minimum of 50 credits must be taken outside of chemistry. This requirement is met through the core, the physics, mathematics, and computer requirements, and electives.

Chemistry students, in consultation with their advisors, are encouraged to consider not only advanced courses in chemistry, but also courses and minors which develop their knowledge and abilities in other sciences, mathematics, engineering, and management.

The total minimum credit requirements for a B.S. degree in chemistry is 120 credit hours.

Chemistry Minor

A minor in chemistry consists of 18-24 credits in chemistry, exclusive of any coursework taken to satisfy the Area III requirements. All course prerequisites must be satisfied. The course requirements for the chemistry minor are as follows:

- a freshman level course (84.121, 84.123, and 84.122, 84.124) or the equivalent must be included;
- four additional courses of which not more than two may be from the same chemistry area;
- at least two courses must carry a laboratory component exclusive of 84.121, 84.123 and 84.122, 84.124;
- a lecture course with a corequisite laboratory course will be considered as one course of the additional course requirements; and

e. at least eight semester hours must be taken at or above the 300 course level, and of these courses, at least three credits must be in a course not required by the curriculum of the student's department.

Sample Course of Study**Freshman Year****Fall Semester**

84.121	Chemistry I	3
84.123	Chemistry I Lab	1
42.101	College Writing I (Gen Ed)	3
92.131	Calculus I (or Calc IA)	4
	General Education Course	3
		14

Spring Semester

84.122	Chemistry II	3
84.124	Chemistry II Lab	1
84.207	Descriptive Inorganic Chem	3
42.102	College Writing II (Gen Ed)	3
92.132	Calculus II (or Calculus IB)	4
91.111	Everyday Computing	2
		17

Sophomore Year**Fall Semester**

84.221	Organic Chemistry I	3
84.227	Organic Chemistry I Lab	2
84.209	Inorganic Lab	2
95.201	Principles of Physics I	3
96.103	Exp Gen Physics I	1
92.231	Calculus III	4
		15

Spring Semester

84.222	Organic Chemistry II	3
84.228	Organic Chemistry II Lab	2
84.260	Information Retrieval	1
95.202	Principles of Physics II	3
96.104	Exp Gen Physics II	1
92.234	Differential Equations	3
	General Education Course	3
		16

Junior Year**Fall Semester**

84.344	Physical Chemistry I	3
84.346	Physical Chemistry I Lab	2
84.313	Analytical Chemistry I	3
84.315	Analytical Chemistry I Lab	2
	General Education Course	3
		13

Spring Semester

84.345	Physical Chemistry II	3
84.350	Physical Bio Inorg Lab	2
84.314	Analytical Chemistry II	3
89.316	Analytical Chem Lab II	2
	Free Elective	3
	General Education Course	3
		16

Senior Year**Fall Semester**

84.334	Inorganic Chemistry II	3
	Chem Elective with Lab*	3/4
	General Education Course	3
	Free Elective	3
	Free Elective	3
		15/16

Spring Semester

84.360	The Responsible Chemist	3
	Chemistry Elective*	3
	Free Elective	3
	Free Elective	3
		15

Total Credits Required: 120

*The senior chemistry electives must be advanced courses which assume or require the basic chemistry courses of the first three years as prerequisites. Senior thesis, 84.407 and 84.408 can count for only one of the two required chemistry electives.

**Chemistry Courses
(Prefix: 84)****84.101 Applied Chemistry for Non-Scientists**

Provides an understanding of basic chemical principles—atomic structure, bonding and interparticle forces, physical and chemical properties of matter through hands-on examination of matter and the application of principles to understanding the chemistry of current issues (e.g., environmental chemistry, biochemistry, food and drug chemistry) and the analysis of problems dealing with these issues. I,II(3,0)3

84.111 General Chemistry I

A one-semester survey of inorganic chemistry: the structure and properties of matter, chemical reactions, stoichiometry, gas laws, solution chemistry, kinetics, equilibrium, and acid-base chemistry. Corequisite: 84.113 I(3,0)3

84.112 General Chemistry II

A survey of the basic principles of organic chemistry and biochemical aspects of carbohydrates, lipids, proteins and nucleic acids. Prerequisite: 84.111 or permission of instructor Corequisite: 84.114 II(3,0)3

84.113 General Chemistry Lab I

Laboratory experiments designed to illustrate the principles covered in 84.111. Corequisite: 84.111 I(0,3)1

84.114 General Chemistry Lab II

Laboratory experiments designed to illustrate the principles discussed in 84.112. Prerequisite: 84.113 or permission of instructor Corequisite: 84.112 II(0,3)1

84.121 Chemistry I

Introduction to basic concepts of chemistry. Topics include chemical calculations, atomic structures, the periodic table, basic bonding theory, solutions, liquids, and gases. Corequisite: 84.123 I(4,0)3

84.122 Chemistry II

A continuation of 84.121. Topics include thermodynamics, kinetics, acids and bases, introduction to organic chemistry, chemical equilibrium, precipitation reactions, and electrochemistry. Prerequisite: 84.121 Corequisite: 84.124 II(4,0)3

84.123 Chemistry I Lab

Experimental study of chemical principles and chemical transformation coordinated with topics considered in 84.121. Examines some of the more important

reactions of elements, oxides, acids, bases, and salts. Other topics include chemical separation, purification, preparation of inorganic salts, quantitative determinations dealing with the formula of a compound, gas laws, and colligative properties. Stresses careful techniques and precise measurements. Corequisite: 84.121 I(0,3)1

84.124 Chemistry II Lab

A continuation of the laboratory study begun in 84.123 that is coordinated with topics of 84.122. Topics include: thermochemistry, kinetics, spectroscopy, titration, pH, equilibrium reaction and constants. Some aqueous solution reactions and organic reactions are examined. Accurate measurements and precise instrumental and apparatus operation are expected. Corequisite: 84.122 II(0,3)1

84.135 Honors Chemistry I

A more in-depth view of the topics covered in Chemistry I, (84.121). Topics include chemical reactions and calculations, atomic history and structures, the behavior of gases and bonding theory. Open to students enrolled in the Honors Program, and may be taken instead of 84.121. Corequisite: 84.123 I(3,0)3

84.136 Honors Chemistry II

A continuation of 84.135. A more in-depth view of the topics covered in Chemistry II (84.122). Topics include solutions, kinetics, thermodynamics, acids and bases, chemical equilibrium, electrochemistry and solubility. Open to students enrolled in the Honors Program, and may be taken instead of 84.122. Prerequisite: 84.121 or 84.135 Corequisite: 84.124 II(3,0)3

84.203 Principles of Organic Chemistry

A one semester survey of the essential concepts, compounds, and reactions of organic chemistry. Open only to Plastics Engineering majors. Corequisite: 84.205 I(3,0)3

84.205 Principles of Organic Chemistry Laboratory

Introduction to the basic skills and techniques used in the synthesis, purification, and characterization of representative organic compounds. Open to Plastics Engineering students in the fall semester and Chemical Engineering students in the spring semester. Corequisite: for Plastics

majors—84.203, for Chemical Engineers—84.222 I,II(0,4)1

84.207 Descriptive Inorganic Chemistry

The chemical behavior, structure and methods of preparation and nomenclature of the more common elements and their compounds. Corequisites: 84.122, 84.124 II(3,0)3

84.209 Inorganic Chemistry Laboratory

Laboratory to study the reactions of ions in aqueous solutions and to carry out inorganic syntheses and characterizations. Prerequisite: 84.207 I(0,4)2

84.221 Organic Chemistry I

Basic principles and reactions which characterize the chemical behavior of carbon compounds. Covers nomenclature, reactions, reaction mechanisms, and stereochemistry. Required for chemistry majors. Prerequisites: 84.122 and 84.124 Corequisite: 84.227 or 84.229 I(4,0)3

84.222 Organic Chemistry II

A continuation of 84.221 including an introduction to infrared and NMR spectroscopy and biochemistry. The application of organic reactions in multi-step synthesis is stressed. Required for chemistry majors. Prerequisite: 84.221 Corequisite: 84.228 or 84.230 II(4,0)3

84.227 Organic Chemistry Lab I

Laboratory work designed to emphasize the techniques of organic synthesis and the use of instrumentation for identification and characterization of organic compounds. Required for chemistry majors. Prerequisite: 84.124 Corequisite: 84.221 I(0,4)2

84.228 Organic Chemistry Lab II

A continuation of 84.227 including an introduction to semimicro organic techniques. Planning and successfully carrying out reactions published in the chemical literature are emphasized. Required for chemistry majors. Prerequisites: 84.221 and 84.227 Corequisites: 84.222 and 84.260 II(0,4)2

84.229 Organic Chemistry Lab IA

Techniques, skills and heuristic approaches in the synthesis, purification, and identification of organic compounds. IR, GC, and NMR instrumental methods are included. Corequisite: 84.221 I(0,4)1

84.230 Organic Chemistry Lab IIA

A continuation of 84.229. Prerequisite: 84.229 Corequisite: 84.222 II(0,4)1

84.260 Information Retrieval

An introduction to the important chemical and chemical-related reference sources including journals, patents, technical publications, and compiled reference works, and instructions in their use. Assignments require the use of each source discussed. On-line searching using computerized chemical and chemical related databases is also introduced. Corequisite: 84.228 II(1,0)1

84.300 Directed Studies in Chemistry I

An introduction to techniques of research. Open only to chemistry majors. Credit does not count toward those for A.C.S. certification nor toward the total of 126 credits for graduation. Prerequisites: four semesters of college level chemistry with laboratory and permission of instructor II(0,3-6)1

84.313 Analytical Chemistry I

Focuses on the evaluation of analytical data, aqueous and non-aqueous acid-base systems, oxidation reduction and complexation equilibria, solubility and precipitation, solvent extraction, ion-exchange and chromatographic methods. Corequisite: 84.315 I(3,0)3

84.314 Analytical Chemistry II

Introduces the student to modern instrumental methods of chemical analysis. Included are such topics as ultraviolet-visible, emission and atomic absorption spectroscopy. The principles and applications associated with mass spectrometry, thermal and electrochemical methods of analysis, chromatographic techniques such as GC and HPLC are also presented. This course is required for chemistry majors and is strongly recommended for students in the M.S. and Ph.D. programs in Environmental Studies with permission of the instructor. Prerequisites: 84.313 and 95.202 Corequisite: 84.316, 84.345 II(3,0)3

84.315 Analytical Chemistry I Lab

Experiments emphasizing the topics presented in 84.313 are conducted. Corequisite: 84.313 I(0,4)2

84.316 Analytical Chemistry II Lab

Laboratory experiments are designed to complement the coverage of topics in 84.314. Prerequisites: 84.313, 84.315 Corequisite: 84.314 II(0,4)2

84.321 Advanced Organic Laboratory

Involves more advanced laboratory work in organic chemistry using modern techniques of synthesis. Instrumentation and chemical methods are used to identify reaction products as well as unknown compounds. Prerequisite: 84.222 I(I,6)3

84.334 Advanced Inorganic Chemistry

An introduction to modern theories of atomic structure and chemical bonding, with emphasis on physical/chemical principles and properties. Considerable time is spent on coordination compounds including topics such as descriptive chemistry, biochemical importance, and ligand field theory. Prerequisite: 84.345 II(3,0)3

84.339 Physical Chemical Principles

A one-semester course designed for plastics engineering majors. Physical chemical concepts of importance to plastics and polymeric materials are emphasized and include kinetics, spectroscopy, phase rule, and statistical thermodynamics. Prerequisites: 84.122, 26.247 Corequisite: 84.341 I or II(2,0)2

84.341 Physical Chemical Principles Lab

Laboratory work designed to exemplify principles and applications covered in 84.339. Corequisite: 84.339 I or II(0,3)1

84.344 Physical Chemistry I

The 84.344/345 sequence covers basic physical chemical topics: laws of thermodynamics, solutions, chemical and phase equilibria, electrochemistry, kinetics, and atomic and molecular structure. Required for chemistry majors. Prerequisite: 92.231 I or II(3,0)3

84.345 Physical Chemistry II

A continuation of 84.344. Required for chemistry majors. Prerequisite: 84.344 I or II(3,0)3

84.346 Physical Chemistry Lab I

Laboratory work designed to exemplify principles covered in 84.344. Required for chemistry majors. Prerequisite: 84.124 Corequisite: 84.344 I or II(0,3)1

84.347 Physical Chemistry Lab II

Laboratory work designed to exemplify principles of chemical kinetics, equilibrium and spectroscopy. Corequisite: 84.345 I or II(0,3)1

84.350 Physical Bioinorganic Chemistry Lab

Coordination compounds are utilized in a

core of experiments to illustrate basic physiochemical techniques and analysis of experimental data in electrochemistry and kinetics. A project lab is carried out to apply and extend techniques learned. Prerequisites: 84.344 and 84.346 or other laboratory experience in thermodynamics Corequisite: 84.345 I(1,3)2

84.360 The Responsible Chemist

Covers topics of importance to chemists involving ethics and values. Following an in-depth consideration of the nature of ethics and values, topics such as chemical safety, the chemical profession, and industrial chemistry are discussed with particular focus on the ethical issues involved. Prerequisite: 6 semesters of chemistry courses II(3,0)3

84.403 Introductory Polymer Science I

Coverage of step and chain growth polymerizations, kinetics and mechanism, copolymerization, ionic and free radical polymerizations, and industrially important polymers. Prerequisite: 84.222 or 84.203, 84.339 or 84.345 I(3,0)3

84.404 Introductory Polymer Science II

An introduction to the physical chemistry of polymers including molecular weight distribution and averages, polymer solutions, fractionation, methods of molecular determination, and structure. Prerequisites: 84.203 or 84.222, 84.339 or 84.345 II(3,0)3

84.405 Polymer Laboratory I

An introductory laboratory in polymer science concerned with the physical and chemical characterization of polymers. Prerequisites: 84.203 or 84.222, 84.345 or 84.339 Corequisite: 84.403 II(0,4)1

84.406 Polymer Laboratory II

An introductory laboratory in polymer science concerned with the techniques of polymer synthesis. Prerequisites: 84.203 or 84.222, 84.345 or 84.339 Corequisite: 84.404 II(0,4)1

Theses

Credit for 84.407/408 Undergraduate Thesis in Chemistry I and II may be used by chemistry majors for credit and as a chemistry elective only when the thesis is under the direction and direct supervision of a member of the chemistry faculty. Interdisciplinary research may be used for chemistry credit only when the thesis is under direct supervision of a member of

the chemistry faculty, with the second department involved in an advisory role or supportive role. When those roles are reversed, or when research is done principally or totally under the direction of a faculty member of another department, the undergraduate research must be taken under the auspices of the other department involved using the corresponding undergraduate research course numbers for that department. The course may then be used as a general elective in the chemistry major program. However, only six credits in any undergraduate research experience will be applied to an academic program in chemistry for the minimum graduation credit. In the case of interdisciplinary research, when one semester is done in another department, a total of six credits for the year may be counted toward graduation with the stipulation that the second semester of research is a continuation of the first semester. In this special case, the student would earn three chemistry credits and three elective credits for undergraduate research.

84.407 Undergraduate Thesis I

Research in biochemistry, electrochemistry or analytical, organic, inorganic, physical or polymer chemistry. Progress report required. Prerequisite: permission of department chairperson and thesis supervisor. For credit for ACS certification, 84.407 must be followed by 84.408 I(0,9-12)3

84.408 Undergraduate Thesis II

A continuation of 84.407. Both semesters must be taken and not more than six credits may be used in meeting degree requirements. A written thesis and seminar are required. The written thesis is to follow the conventional form of introduction, literature survey, data, results, and conclusions. One copy of the thesis must be filed in the Department office. Prerequisite: permission of the department chairperson and thesis supervisor II(0,9-12)3

84.419 Introductory Biochemistry

An introductory study of the fundamental principles of biochemistry including the chemistry of proteins, carbohydrates, nucleic acids and lipids, thermodynamics, kinetics and mechanisms of enzyme action, intermediary metabolism and selected topics in molecular biology. Prerequisites: 84.222, 84.344, or permission of instructor I(3,0)3

84.420 Introductory Biochemistry Lab

Laboratory experiments designed to acquaint the students with modern techniques in biochemistry and to emphasize material covered in 84.330. Prerequisite or corequisite: 84.419 or permission of instructor II(0,6)2

84.423 Advanced Organic Chemistry I

Extension of introductory organic chemistry. Organic reactions and compounds are discussed in terms of reaction mechanisms, structure-reactivity and stereochemistry. Prerequisite: 84.222 I(3,0)3

84.424 Advanced Organic Chemistry II

Synthesis of organic molecules. Selected reagents and techniques are discussed with emphasis on the scope and limitations of these reactions. The reaction mechanisms are also discussed. Prerequisite: 84.423 or permission of instructor II(3,0)3

84.425 Industrial Organic Chemistry

An advanced organic chemistry course dealing with the synthesis of large volume organic materials and their industrial and consumer uses. An area of particular focus is the manufacture of pharmaceuticals ranging from over-the-counter drugs to ethical drugs. Prerequisites: 84.222, 84.339 or 84.344 I(3,0)3

Primarily for Graduate Students

All graduate courses are open to undergraduate students with the permission of the instructor.

84.510 Electron Microscopy of Advanced Materials

Introduces the principles and practical applications of electron microscopy analytical methods for ceramics, electronic materials, polymers and biological materials. Includes theories of instruments and hands on laboratory experience in their use. Prerequisite: permission of instructor II(3,0)3

84.513 Spectroscopy

A theoretical and practical interpretation of molecular spectra and an introduction to lasers and their applications to spectroscopy. II(3,0)3

84.514 Advanced Analytical Chemistry

Designed to provide graduate students and senior undergraduate students with an

understanding of the principles and the theory of analytical measurements and instrumentation. The course is divided into three sections consisting of a) analytical measurements including potentiometry and voltammetry, b) spectrophotometric measurements (i.e. molecular spectrometry), and c) ionic equilibria and statistics. This course is required for graduate programs in Analytical Chemistry and Environmental Studies (Ph.D.) and is recommended for students in other graduate programs such as Biology, Biochemistry and Environmental Studies (M.S.) and other areas of chemistry. Prerequisite: permission of instructor I(3,0)3

84.517 Glass Working

Fundamental techniques in the preparation and assembling of glass apparatus. The student practices the art and science of scientific glass blowing. Skill in the assembly of simple scientific glass apparatus is stressed. Open to all students. Prerequisite: permission of instructor II(2,3)3

84.519 Environmental Chemistry III (Marine Chemistry)

Covers chemical processes and measurements in marine and estuarine systems. Emphasis is placed on water column processes; however, air-water and sediment-water interface phenomena are covered as well. Topics include but are not limited to: ionic equilibria, trace metal complexation, redox processes, mathematical modeling applied to chemical systems, and oceanographic sampling. Prerequisite: permission of instructor I(3,0)3

84.521 Physical Organic Chemistry

Quantitative aspects of the study of organic reaction mechanisms. Kinetic methods, linear free energy relationships, orbital symmetry effects, and other selected topics are covered. Prerequisites: 84.423, 84.523 or equivalent I(3,0)3

84.523 Organic Reaction Mechanisms and Structures

Provides insight into how reactions occur and how reaction mechanisms are studied. Emphasis is placed on bonding, structure and reactivity. Conformational analysis and stereoelectronic effects, including an introduction to the application of computational chemistry to these subjects. I(3,0)3

84.524 Organic Synthesis

Mechanism, scope and limitations of important selected types of reactions and design of synthetic sequences. Emphasis is placed on methodology of synthesis and current literature. Prerequisite: 84.523 or permission of instructor III(3,0)3

84.525 Analysis of Advanced Materials

Introduces the principles and practical applications of scanning probe microscopy and X-ray diffraction methods for ceramics, electronic materials, polymers, and biological materials. Hands-on laboratory sessions provide details of the operation of the instrumentation involved. Prerequisite: permission of instructor I(3,0)3

84.526 Theory and Applications of Chromatography

Coverage directed to the performance of packed and capillary column for gas chromatography and HPLC. Modern injection, detector and pumping systems used in chromatography are also discussed. Prerequisite: permission of instructor I or II(3,0)3

84.527 Stereochemistry

The fundamental concepts of symmetry and optical activity. The relationship of stereostructures to the physical and chemical properties of organic compounds. Offered in alternate years. Prerequisites: 84.523 and 84.524 or equivalent I(3,0)3

84.528 Electroanalytical Chemistry

Intent is to present an introduction to the theory and application of modern electroanalytical chemistry. The course is divided into a discussion of electrode processes, electroanalytical techniques, and the instrumentation required to make electrochemical measurements. Modern polarography, stationary electrode voltammetry, chronoamperometry, bulk electrolysis, chronopotentiometry and hydrodynamic electrochemistry are among the topics considered. A detailed discussion of the design and operation of electrochemical detectors is presented. Prerequisite: 84.314 or permission of instructor I or II(3,0)3

84.531 Statistical Thermodynamics

Fundamentals of equilibrium statistical mechanics, classical and quantum statistics. Molecular theories of gases, crystals, and liquids with emphasis on chemical aspects. Electrolyte and non-electrolyte solutions, polymer and polyelectrolyte sys-

tems, chemical equilibria and reaction rate processes. Also, an introduction to non-equilibrium statistical theories.

Prerequisite: 84.532 or equivalent I(3,0)3

84.532 Advanced Physical Chemistry

Extension of introductory physical chemistry. Open to undergraduates and graduate students in chemistry and related fields. Emphasis is placed on classical and statistical thermodynamics; surface and colloid chemistry; and electronic and vibration-rotation spectra. Prerequisite: 84.344 and 84.345 or permission of instructor II(3,0)3

84.534 Quantum Chemistry

Principles and methods of quantum mechanics with special attention to chemical applications such as electronic structure of atoms and molecules, vibrations and rotation of molecules, and interaction of radiation and matter. Prerequisite: 84.532 or equivalent I or II(3,0)3

84.535 Advanced Topics in Physical Chemistry

Selected topics and recent advances in physical chemistry. Selection of topics is at the discretion of the instructor. Prerequisite: permission of instructor I(3,0)3

84.536 Advanced Topics in Physical Chemistry

Same as 84.535 with different topics. Prerequisite: permission of instructor II(3,0)3

84.538 Biochemical Mechanisms

Discussion of various biochemical reactions from the point of view of organic reaction mechanisms. Kinetics, coenzymes and methods of the study of enzyme and catalysis and mechanisms is emphasized. Prerequisite: 84.551 or permission of instructor II(3,0)

84.540 Chemical Kinetics

The theoretical and empirical treatment of chemical kinetics data as well as the methods of obtaining these data. Determination of the order of reactions, factors influencing rates, application of rate studies in establishing hypotheses for reaction mechanisms, collision theory and absolute rate theory. Prerequisite: 84.345 or equivalent II(3,0)3

84.543 Modern Inorganic Chemistry

A theoretical treatment of atomic structure and chemical bonds, included are

such topics as Russell Saunders' coupling, molecular orbital theory, ligand field theory, and descriptive coordination chemistry. Prerequisite: one year of physical chemistry. I(3,0)3

84.545 Advanced Physical Chemistry for Environmental Studies

Coverage of the key areas of physical chemistry with emphasis on the topics with applications in environmental chemistry. For environmental science graduate students only. I or II(3,0)3

84.546 Organic Chemistry for Environmental Studies

A review of fundamental organic chemistry with emphasis on aspects with particular relevance to environmental chemistry. For environmental science graduate students only. I or II(3,0)1

84.550 Biochemistry I

An advanced study of the structure and properties of proteins, nucleic acids, carbohydrates and lipids including kinetics and mechanisms of enzyme action and detailed description of metabolic pathways of carbohydrates and lipids. Prerequisites: 84.222 and 84.339 or 84.344 or permission of instructor I(3,0)3

84.551 Biochemistry II

A continuation of 84.550 with emphasis on metabolic pathways of amino acids and nucleic acid, biosynthesis of proteins and selected topics in molecular biology and various areas of biochemistry. Prerequisite: 84.550 or permission of instructor II(3,0)3

84.556 Electronics and Instrumentation for Science

Covers the theory and applications of electronics in modern chemical instrumentation II(2,3)4

84.560 Advanced Physical Biochemistry

Physical chemistry encompasses a group of principles and methods helpful in solving many different types of problems. This course will present selected principles of thermodynamics, kinetics, statistical thermodynamics and quantum mechanics as they are applied to biochemical systems. Various experimental techniques will be strongly emphasized in view of their importance in biochemical research. Prerequisite: 84.345, 84.550 or permission of instructor I(3,0)3

84.563 Chemistry of Natural Products

Covers the proof of structure of various types of natural products, approaches to the total synthesis of these products and the biosynthetic pathways. Prerequisite: 84.524 or 84.568 or equivalent I(3,0)3

84.568 Structural Analysis

Practical applications of instrumental data in the determination of the structure of organic compounds and polymers.

Includes mass spectrometry, ultra-violet spectroscopy, infrared spectroscopy and nuclear magnetic resonance spectroscopy. Open to undergraduate students with permission. Prerequisite: 84.222 or equivalent II(3,0)3

84.580 Advanced Analytical Biochemistry

Analytical biochemistry involves the separation, detection, and analysis of biological molecules. This course addresses advanced theory and applications of contemporary biochemical techniques and instrumentation. Topics covered include chromatographic and electrophoretic separation techniques, detection of biomolecules by spectroscopy and radiochemical methods, biological preparations, and structural analysis of proteins, nucleic acids, polysaccharides and lipids. Prerequisite: 84.550 or permission of instructor II(3,0)

Polymer Chemistry Courses (Prefix: 97)

Courses in polymer chemistry are primarily for graduate students but are open to undergraduates with the permission of the instructor.

97.503 Advanced Polymer Science I

A study of the principles of condensation, free radical, ionic, coordination and ring opening polymerization. The topics include the effect of polymerization techniques on reaction kinetics and molecular weight, and the evaluation of reactivity ratios in copolymerization reactions. Prerequisite: permission of instructor I(3,0)3

97.504 Advanced Polymer Science II

Introduction to chain statistics and thermodynamics of macromolecular solutions, methods of study of molecular weight and chain conformation, and the properties of

polymers in bulk including viscoelasticity and crystallinity. Prerequisite: permission of instructor II(3,0)3

97.505 Polymer Preparation and Characterization

An advanced laboratory in polymer science concerned with the synthesis and characterization of macromolecules. Prerequisite: permission of instructor I(0,4)1

97.511 Biopolymers

Topics include conformation and configuration of vinyl polymers and polypeptides, energetics of chain folding and examination of the forces dictating ordered structures, helix to coil transitions in biopolymers with emphasis on polypeptide structures, instrumental analysis of biopolymer conformation, synthesis of biopolymers including polypeptides, polysaccharides and polynucleotides, and examination of relationships between synthetic polymers and naturally occurring polymers. Prerequisite: permission of instructor I(3,0)3

97.512 Properties of Bulk Polymers

Structure and properties of bulk polymers in the glassy, rubber and crystalline states. Topics include chain statistics, rubber elasticity, crystalline polymers, glass transition, segmental motion and viscoelasticity. Prerequisite: permission of instructor II(3,0)3

97.549 Physical Chemistry of Macromolecules

Physical chemistry of polymer including structure and conformation, chain statistics, molecular weight distributions and averages, polymerization kinetics and classical and statistical thermodynamics of polymer systems including polyelectrolytes. Prerequisite: 97.503 or equivalent I(3,0)3

97.550 Physical Chemistry of Macromolecules II

Optical and hydrodynamic properties of polymer solutions. Methods of determination of structural parameters, including light scattering, viscometry, and other techniques. Prerequisite: 97.503 or equivalent II(3,0)3

97.553 Organic Chemistry of Macromolecules

An advanced study in polymer science concerned with the synthesis of macro-

molecules and their mechanisms of formation. Prerequisites: 97.503, 97.504 I(3,0)3

97.651 Selected Topics in Polymer Science

Advanced topics in various aspects of polymer science. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge in the field of macromolecules. Prerequisite: permission of instructor I or II(3,0)3

97.751 Advanced Projects in Polymer Science

Special projects undertaken by a student to expand knowledge in a specific field not necessarily related to the thesis. Content of project and hours assigned must be approved by the department chair. I or II(3,0)1

Department of Computer Science

Thomas Costello, Chairperson

Undergraduate Coordinator: John Sieg

Graduate Coordinator: Stuart Smith

Professors: Thomas Costello, Georges Grinstein, Raymond Gumb, Patrick Krolak, Robert Lechner, Giampiero Pecelli, Stuart Smith

Associate Professors: John Buford, James Canning, Jesse Heines, Byung-Guk Kim, Haim Levkowitz, William Moloney, John Sieg, Charles Steele

Assistant Professor: Marian Williams

Department Location: Olsen Hall, Room 315

Telephone: (978) 934-3620

Computer science is the study of the design and use of computer systems. The goal of the computer science curriculum is to provide the student with the tools to identify those problems that are best solved by means of a computer and to design and implement effective, economical, and creative solutions.

The curriculum's required courses give the student a strong foundation in both the software and hardware aspects of computing, as well as the mathematics and science that underlie the discipline. The electives in the later years allow the student to study more deeply some particular area of computer science.

Graduates of the Department of Computer Science are well trained in systems software design and implementation and have found ready employment in local companies. The Department's courses and programs continue to respond to changing requirements for professional employment in computer science.

Detailed information about the Department of Computer Science is available at the web site <http://www.cs.uml.edu/>.

The Computer Science Major Summary of Degree Requirements

I. General Education Requirements

Students who enrolled in Fall 1993 and later must satisfy the General Education requirements. Computer science majors automatically satisfy the Mathematics and Sciences parts of the General Education requirements. The remaining requirements are as follows:

College Writing	6 cr
Literature	3 cr
Historical Studies	3 cr
Aesthetics	3 cr
Behavioral and Social Studies	6 cr
Values, Concepts, and Choice	3 cr

II. Major Requirements

A. Computer Science courses

91.101 Computing I & Lab	4 cr
91.102 Computing II	4 cr
91.201 Computing III	4 cr
91.203 Comp Org & Assem Lang	4 cr
91.204 Computing IV	3 cr
91.301 Org of Programming Lang	3 cr
91.304 Foundations Computer Sci	3 cr
91.305 Computer Architecture	3 cr
91.308 Intro to Operating Systems	3 cr
91.404 Analysis of Algorithms	3 cr

C S Project Sequence 3-6 cr

All Computer Science majors must take a one- or two-semester project course from an approved department list. Students who take an approved one-semester project course such as Compiler Writing must take two Computer Science electives; otherwise, one is needed. Students may not elect more than a total of six credits from any combination of the following: 91.401, 91.402, 91.460, and 91.490.

Current project course sequences include

91.309 Database I	
91.310 Database II	
91.353 GUI Programming I	
91.461 GUI Programming II	

91.401 Software Project Lab I

91.402 Software Project Lab II

91.406 Introduction to Compiler Writing

91.413 Data Communications I

91.414 Data Communications II

91.420 Artificial Intelligence

91.421 Knowledge-Based Systems

91.427 Graphics I

91.428 Graphics II

Because this list is subject to continuous revision, students should check with their advisors for the latest information. Some project sequences are not offered every school year. Thus, you should take the second course of a project sequence the semester after you take the first course of that sequence.

Computer Science electives appear under the heading "Computer Science Electives" in the course listing. Most 500-level computer science courses can also be used as computer science electives. For example, undergraduates often are qualified to take 91.502, 91.515, 91.521, 91.522, 91.538, 91.539, 91.540, 91.541, 91.543, or 91.546.

B. Supporting Courses in Science and Mathematics

92.131 Calculus I	4 cr
92.132 Calculus II	4 cr
95.141 Physics I & Lab	4 cr
95.144 Physics II & Lab	4 cr
92.231 Calculus III	4 cr
92.321 Discrete Structures I	3 cr
92.322 Discrete Structures II	3 cr
92.386 Statistics for Sci/Eng	3 cr
16.265 Logic Design	3 cr

C. Additional Writing Requirement 3 cr

42.220 Each student must take 42.220, Oral and Written Communication for Software Developers.

D. Ethics and Social Issues Elective

Each student who began the computer science major in September of 1998 or later must take an ethics and social issues elective chosen from a list available in the Computer Science Department Office and at the department's web site. Courses on this list usually can also be used to satisfy one of the General Education Requirements.

E. Quantitative Elective Courses 6 cr

Each student must take two three-credit courses in quantitative areas outside of Computer Science or Pure Mathematics. Courses in Applied Mathematics, Engineering, the Sciences and other areas of an advanced quantitative content satisfy this requirement. In the social sciences, courses that have calculus or mathematical statistics as prerequisites satisfy this requirement. A list of approved quantitative electives is available in the Computer Science Department Office and at the department's web site.

F. Unrestricted General Elective Courses

12 cr

Students in the Class of 1998 and later must ordinarily take four three-credit general (or "free") electives. Courses from any academic department are acceptable as general electives. However, science, mathematics, and engineering courses, and courses with a computing component, if taken after Computing I has been taken, must be at a level higher than that of courses required by the Computer Science program.

III. Academic Standing

Beginning with the first semester of the sophomore year, and every semester thereafter, each computer science major must maintain

1. a GPA of 2.5 or better in required computer science courses, project courses, and computer science electives
2. an overall GPA of 2.3

Students who fail to satisfy these requirements will have their records reviewed by the department's Undergraduate Committee and may be dropped from the computer science program.

BS/MS program

The Computer Science Department has a BS/MS degree program. Two advantages of the program are 1) the ability in some cases to count computer science courses for both your BS program and your MS program and

2) being accepted into the MS program without taking the Graduate Record Examination.

To be accepted in this program, you must have good grades and apply in your Junior year. There are many rules governing eligibility for the program. Applicable Graduate School rules appear in Graduate School Catalog.

There are advantages and disadvantages to getting your Masters degree at the same place you received your BS. If you are interested in the BS/MS program, please discuss it with your academic advisor or other faculty member.

The Computer Science Minor

The Computer Science minor is primarily intended for students in the sciences, engineering, or other field with a substantial quantitative component. The following courses are required for completion of the computer science minor:

91.101	Computing I & Lab	4
91.102	Computing II	4
91.201	Computing III	4
91.203	Comp Org & Assem Lang	4
91.	300/400 level course	3
91.	300/400 level course	3

In addition, either 92.321 (Discrete Structures I) or 92.211 (Linear Algebra) must be taken before any computer science course numbered 91.301 or higher.

Suggested Curriculum

For students entering program as freshmen in September 1994 and subsequently

Freshman Year**Fall Semester**

91.101	Computing I	4
92.131	Calculus I	4
95.141	Physics I & Lab	4

42.101	College Writing I	3
		15

Spring Semester

91.102	Computing II	4
92.132	Calculus II	4
95.144	Physics II & Lab	4
42.102	College Writing II	3
		15

Sophomore Year**Fall Semester**

91.203	Comp Org & Assem Lang	4
91.201	Computing III	4
92.231	Calculus III or	
16.265	Logic Design	4/3
92.321	Discrete Structures I	3
		15/14

Spring Semester

91.204	Computing IV	3
92.386	Statistics for Sci/Eng	3
92.322	Discrete Structures II	3
16.265	Logic Design or	
92.231	Calculus III	3/4
42.220	Oral and Written Comm	3
		15/16

Junior Year**Fall Semester**

91.304	Foundations of Comp Sci	3
91.305	Computer Architecture	3
	Quantitative Elective	3
	GER Course	3
	GER Course	3
		15

Spring Semester

91.301	Organization of Prog Lang	3
91.308	Intro to Operating Syst	3
	Quantitative Elective	3
	GER Course	3
	GER Course	3
		15

Senior Year**Fall Semester**

91.	Project Course (1)	3
91.404	Analysis of Algorithms	3
	GER Course/Ethics Course*	3
	General Elective	3
	General Elective	3
		15

Spring Semester

91.	Project Course (2)	3
	CS Elective	3
	GER Course	3
	General Elective	3
	General Elective	3
		15

*Normally a course that satisfies the Computer Science Department's Ethics and Social Issues Requirement also satisfies one of the university's General Education Requirements.

**Computer Science Courses
(Prefix:91)****91.101 Computing I**

Introduction to computing environments; introduction to an integrated development environment; C or C++ language. Linear data structures; arrays, records, and linked lists. Abstract data types, stacks, and queues. Simple sorting via exchange, selection, and insertion. Basic file I/O. Programming style, documentation, and testing. Ethical and social issues. 4 cr

91.102 Computing II

Pointers. Lists, stacks, and queues. Binary trees, AVL trees, n-ary trees. Advanced sorting via quicksort, heapsort, etc. Sets and hashing. Characters and strings. Graphs. Advanced file techniques. Recursion. Programming style, documentation, and testing. Ethical and social issues. Prerequisite: 91.101 4 cr

91.201 Computing III

Object-oriented programming. Classes, methods, polymorphism, inheritance. Object-oriented design. C++. UNIX. Ethical and social issues. Prerequisite: 91.102 4 cr

**91.203 Computer Organization and
Assembly Language**

The organization and operation of a conventional computer, including principal instruction types, data representation, addressing modes, program control, and I/O. Assembly language programming, including instruction mnemonics, symbolic addresses, assembler directives, system calls, and macros. The usage of text editors, symbolic debuggers, and loaders. The use of pseudocode in guiding structured assembly language programming. Prerequisite: 91.101 4 cr

91.204 Computing IV

Construction of program-translation software, such as compilers, assemblers, and linkers. Software engineering principles and practice. Object-oriented analysis and design. UNIX. CASE productivity aids. Prerequisites: 91.201, 91.203 3 cr

**91.301 Organization of Programming
Languages**

Analytical approach to the study of programming languages. Description of the salient features of the imperative, functional, logical, and object-oriented programming paradigms in a suitable meta-language such as Scheme. Topics include iteration, recursion, higher-order functions, types, inheritance, unification, message passing, orders of evaluation, and scope rules. Elementary syntactic and semantic descriptions. Implementation of simple interpreters. Prerequisites: 91.204 3 cr

**91.304 Foundations of Computer
Science**

A survey of the mathematical foundations of Computer Science. Finite automata and regular languages. Stack Acceptors and Context-Free Languages. Turing Machines, recursive and recursively enumerable sets. Decidability. This course involves no computer programming. Prerequisite: 92.322 3 cr

91.305 Computer Architecture

An examination of the basic functional components of a computer system including the CPU, memory systems, and I/O systems. Each of these three areas will be developed in detail with a focus on the system design and component integration. Topics will include CPU control and ALU operation, computer timing, data address and I/O bus activity, addressing model,

programmed and DMA I/O, and instruction sets and microcode. Prerequisites: 91.203, 16.265, 91.102 3 cr

**91.308 Introduction to Operating
Systems**

An introduction to major operating systems and their components. Topics include processes, concurrency and synchronization, deadlock, processor allocation, memory management, I/O devices and file management, and distributed processing. Techniques in operating system design, implementation, and evaluation. Prerequisite: 91.305 3 cr

91.404 Analysis of Algorithms

Development of more sophisticated ideas in data type and structure, with an introduction to the connection between data structures and the algorithms they support. Data abstraction. Controlled access structures. Trees, lists, graphs, arrays; algorithm design strategies: backtracking, greedy strategy, divide and conquer, branch and bound. Elementary techniques for analysis: recursion equations, estimation methods, elementary combinatorial arguments. Examination of problem areas such as searching, sorting, shortest path, matrix and polynomial operations, and the indicated representations and algorithms. The student will use the techniques learned in this course and in previous courses to solve a number of logically complex programming problems. Prerequisites: 91.201, 92.322 3 cr

Computer Science Electives**91.309 Database I**

This course surveys topics in database management systems. Topics include access methods, data models (network, hierarchical, relational, semantic, and object-oriented), query languages, database design, query optimization, concurrency control, recovery, security, integrity, client-server architecture, and distributed database systems. A database application project will be assigned. Prerequisite: 91.204 3 cr

91.310 Database II

Advanced topics in database systems, including distributed database systems, query optimization, concurrency control, knowledge bases, deductive databases, extensibility, and object-oriented database

systems. Additional topics may include benchmarking, scientific databases, and parallelism. Software engineering principles will be applied to the development of components of a database management system. Prerequisite: 91.309 3 cr

91.321 Network and Systems Management

This course will cover technical aspects of UNIX and VMS, and will prepare the student to manage a complex, heterogeneous computing environment. Students should expect substantial amounts of experience with all activities related to the management of the Computer Science Department network. 3 cr

91.330 Symbolic Logic

Propositional logic and first-order predicate logic. Natural deduction and other proof systems. Semantics. Applications to natural and artificial languages. 3 cr

91.350-91.354 Selected Topics

Depends on faculty interest, student demand, and developments in the field. May include: file management, software tools. Prerequisite: junior status Variable 1-3 cr

91.353 GUI Programming I

This is a first course in the design and implementation of graphical user interfaces for windowing environments. Prerequisites: 91.201, good programming and documentation skills 3 cr

91.401 Software Project Lab I

Specification, design, and implementation of a one- or two-semester software project proposed to a directing faculty member. Projects may be proposed as a one- or two-semester effort based on faculty approval. A two-semester effort requires subsequent registration for 91.402. Prerequisite: Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to department chairperson 3 cr

91.402 Software Project Lab II

A continuation of 91.401. Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to the department chairperson. Prerequisite: 91.401 3 cr

91.403 Operating Systems Practicum

Construction of real operating systems.

Topics will include case studies of systems such as UNIX, MULTICS, and CP/M; structured design; and performance techniques. Group projects will be employed to design, build, and evaluate various operating systems modules. Prerequisites: 91.308 and permission of instructor 3 cr

91.405 Parallel Processing

A study of parallel architectures and parallel algorithms, including classification of architectures, characterization of performance, design of parallel algorithms, evaluation of parallel software, and languages for parallel processing. Students will write and execute programs for several different parallel machines. Prerequisite: 91.308 3 cr

91.406 Introduction to Compiler Writing

Includes both theory and practice. A study of grammars—specification and classes; the translation pipeline: lexical analysis, parsing, semantic analysis, code generation and optimization; and syntax-directed translation. Use of automatic generation tools in the actual production of a complete compiler for some chosen language(s). Prerequisites: 91.204, 91.301 3 cr

91.412 Software Engineering

Software development methodologies for large-scale systems. Project organization, life cycle concept, data modeling, structured analysis and design, information hiding, and the use of computer-aided software engineering (CASE) tools. Team projects are required; these emphasize the design, documentation, and maintenance of complex software systems. Not open to students who have taken 91.523 Software Engineering I. Prerequisites: 91.201, 91.204, permission of instructor. 3 cr

91.413 Data Communications I

Techniques of data transmission over analog lines. Properties of communication channels. Error control techniques. Line-, message-, and packet-switching techniques. Communication software architectures. Prerequisites: 91.203, 91.305 3 cr

91.414 Data Communications II (Distributed Systems)

Emphasis on local area networks and communication protocol architectures. A laboratory with RS232-based token ring network and UNIX sockets. Prerequisites: 91.308, 91.413 3 cr

91.420 Artificial Intelligence

LISP. Tree and graph searching algorithms: breadth first, depth first, uniform cost. Heuristic search methods, admissibility. Games: mini-max, alphabeta. Theorem-proving and question-answering. Prerequisite: 91.301 3 cr

91.421 Knowledge-Based Systems

Other topics in artificial intelligence not covered in 91.420, such as computer vision, speech recognition, robotics, expert systems, computer art, computer music. Prerequisites: 91.420 and permission of instructor 3 cr

91.422 Computer Vision

An introductory course in computer vision. This course covers all the recognized computational aspects of vision. It presents computational techniques whenever possible, formulae, algorithms, and programs. Psychological theories are covered only to the extent that they have clear computational implications. Prerequisite: permission of instructor 3 cr

91.427 Computer Graphics I

Introduction to graphics systems and concepts. History of graphics. Introduction to hardware, software, and mathematical tools. Graphics languages and APIs (GKS, PHIGS, Direct 3D, OpenGL). Graphics data structures and algorithms for 2D and 3D modeling and viewing. Input, archiving, and display architectures. Introduction to hidden line and hidden surface removal. Prerequisites: 91.201, 92.231 3 cr

91.428 Computer Graphics II

An advanced course in computer graphics for students familiar with basic issues in computer graphics. Details on hidden line and surface removal. 2D and 3D curve and surface generation. Rendering, illumination, and color models. Realism through precision (ray tracing) and imprecision (fractals). Windowing and user interface management systems. Modern hardware architectures. Animation and simulation systems. Prerequisite: 91.427 3 cr

91.430 Semantics of Programming Languages

Introduction to the Semantics of Programming Languages. Axiomatic, operational, denotational, and translation- al semantics. Program specification. Program proofs using the techniques of Floyd and Hoare. Prerequisites: 91.301 and 91.304 3 cr

91.431 Computational Logic

Semidecision procedures for first-order logic and their correctness. Tableaus, unification, and resolution. Horn clauses and logic programming. Selected topics in areas such as nonstandard logics and architectures. Prerequisites: 91.301 and 91.304 3 cr

91.450 Robotics I

The factories of the future (FOF) will require an integration of knowledge and experience from a variety of engineering and science disciplines. Further, the FOF will be strongly information driven and will involve artificial intelligence, machine vision, and robotics. This design course will feature projects and laboratory work at the bench top and prototype level in flexible manufacturing. The projects will involve using and programming robotics and designing of parts orientation and delivery systems. Simple CAD/CAE/CIM systems will also be developed to support the operation of the FOF. Prerequisites: junior standing in Computer Science or Engineering 3 cr

91.451 Robotics II

A continuation of 91.450. Prerequisite: 91.450 3 cr

91.452 Diagnostic and Test Software Design

Virtually all major hardware products include the design and implementation of diagnostic and verification software as part of the product life-cycle. This course will examine the details of such test software and the diagnostic software for various hardware devices such as disk and tape subsystems. Prerequisite: 91.201, 91.204, 91.305 3 cr

91.453 Real-Time Programming

A survey of the programming techniques needed for applications in which a computer monitors or controls a process whose logical sequence is asynchronous to that of the computer. Topics covered include polling, single and multiple interrupts, masked and vectored interrupts, synchronization mechanisms, critical sections, hardware interfaces, sampled-data systems, and feedback and control. Students will implement several microprocessor-based applications. Prerequisites: 91.308, 16.267 3 cr

91.456 Speech Recognition and Synthesis

This course surveys the techniques by which computer systems can generate and recognize human speech. Students will be introduced to all aspects of this interdisciplinary field (including computer science, artificial intelligence, acoustics, linguistics, psychology, physiology, physics, and signal processing). Working in teams, students will implement parts of a modern speech system and explore the capabilities and limitations of present day technology. Prerequisite: permission of instructor 3 cr

91.457 Computer Security

Basic concepts of cryptography, data security, information theory, complexity, number theory, and finite field theory; encryption algorithms including the Data Encryption Standard (DES) and public key systems; incorporating cryptographic controls into computers; key management; access controls; information flow controls; and inference controls. Prerequisites: 91.404, 92.322, 92.386 3 cr

91.458 Computer Performance Evaluation

The objectives of this course are 1) to provide both analytic and simulation skills useful in evaluating a computer system, and 2) to study available techniques of modeling a given system so that meaningful statistics (such as response times) can easily be obtained. The course will cover the following major areas: 1) review of probability theory and statistics; 2) queuing theory; 3) performance evaluations of time-sharing, batch, or mixed computer systems; 4) performance evaluations of distributed systems. Other topics such as performance measurement techniques, and data analysis will also be covered. Prerequisites: 91.308, 92.386 3 cr

91.459 Human Factors in the Design of Interactive Systems

This course sensitizes students to the factors one must consider in designing interactive systems. Gives them experience in developing interactive software for use by people other than themselves, and discusses tools and techniques for evaluating the effectiveness of interactive software. Course work consists of readings, class discussions, the researching and writing of a term paper, and the design and implementation of an interactive programming project. Prerequisite: 91.201 3 cr

91.460 Selected Topics

Depends on faculty interest, student demand, and developments in the field. May include: computability, formal languages, automata, VLSI design, computer aided design (CAD), computer aided instruction (CAI), semantics of programming languages. Prerequisites: Senior status, permission of instructor Variable 1-3 cr

91.461 GUI Programming II

A second course in the design and implementation of graphical user interfaces for windowing environments. Prerequisite: 91.353 3 cr

91.490 Directed Studies in Computer Science

Individual study for a student desiring more advanced or more specialized work. This course may not be taken more than twice and may not be substituted for scheduled offerings. Prerequisite: Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to the department chairperson 3 cr

Courses for Non-majors

These courses do not count as Computer Science major courses. You may receive general-elective credit for them. However, you may not receive credit for any of these courses after you have taken Computing I. In addition, Continuing Education offers many courses with Computer Science course numbers that are not open to computer science majors.

91.111 Computing in the Everyday World

A non-technical introduction to computer science. The historical development of computational aids and their use in various cultures and societies. Modern examples of computational aids, including integrated word processing/spreadsheet/database environments. 3 cr

91.113 Exploring the Internet

This course covers the tools needed to navigate the Internet: e-mail, telnet, and ftp; listservs and Usenet news; andarchie, WAIS, Gopher, the World-Wide Web, and Mosaic. This course also gives students basic computer programming skills and sufficient knowledge of UNIX to use

Internet tools confidently and efficiently.
3 cr

91.114 Advanced Internet

A continuation of 91.113, Exploring the Internet. Advanced topics for experienced Internet users, including setting up Internet connections, creating Web pages that incorporate images and sound, building your own Internet information site, and using the advanced features of the standard Internet tools. Students will learn and use the full capabilities of HTML (HyperText Markup Language). Each student will carry out a substantial final project. Prerequisite: 91.113
3 cr

91.115 Developing Database Applications

How to design and implement a complete database application using a modern relational database system. Relations, queries, forms, and reports. Objects and properties. Data design and software design. Rapid application development tools. Prerequisite: experience using Microsoft Windows(r)
3 cr

91.211 Computer Science for SRT Applications.

This course is an introduction to C programming, with applications in sound recording technology. Students will write and execute several programs that perform operations pertinent to SRT, including manipulating MIDI codes, performing simple signal processing functions, processing sampled data, and synthesizing sound algorithmically. 3 cr

91.250 Data Structures, Algorithms, and C

A survey of data structures and algorithms. Includes an intensive introduction to the programming language C. Prerequisite: some programming experience
4 cr

91.263 FORTRAN Programming

An introduction to computer programming using FORTRAN 90/95. Programming arithmetic, decisions, repetition, and input/output. Arrays and array processing, including simple algorithms for searching and sorting. The edit-compile-test cycle.
3 cr



Department of Criminal Justice

Eve S. Buzawa, Chairperson

Coordinator of the Graduate Program:
Alan Lincoln

Professors: Eve S. Buzawa, James M. Byrne, David Hirschel, Gerald T. Hotaling, Rene G. Kasinsky, Alan Lincoln, Larry Siegel

Assistant Professors: Donald Hummer, Carolyn Petrosino, Brandon C. Welsh

Adjunct Faculty: Ronald P. Corbett, Jr., Garrett M. Sheehan

Department Location: Mahoney Hall, Room 214

Telephone: (978) 934-4139

Criminal Justice Major

The University of Massachusetts Lowell offers a Bachelor of Science Degree in Public Service with a concentration in the Administration of Criminal Justice. This program offers a strong concentration in professional courses while simultaneously assuring the student a traditional well-rounded liberal arts education. The typical student takes between 36 and 48 credits in professional courses.

In addition to this the student majoring in the administration of Criminal Justice will fulfill a professional skills requirement. This consists of either attaining intermediate proficiency in a foreign language, or completing four courses in computers and statistics. In the event that the student chooses the foreign language skill, the University recommends Spanish.

Students wishing to transfer into Criminal Justice from another major or from another accredited Institution must present a grade point average of at least 2.5 on a 4.0 scale.

Basic Requirements

The major of Administration of Criminal Justice consists of at least 36 credits in criminal justice courses, of which at least 5 courses shall be at the 300 course level or above.

1. Required courses (18 credits)

- 44.101 The Criminal Justice System
- 44.221 Criminology
- 44.234 Criminal Law
- 44.390 Introduction to Criminal Justice Research
- 44.496 Criminal Justice Practicum or
- 44.494 Criminal Justice Field Seminar I and
- 44.495 Criminal Justice Field Internship II (Students will select 44.494 and 44.495 simultaneously)

Note: Students with prior criminal justice experience or students in the evening school will substitute either 44.370 C.J. Management or 44.371 C.J. Planning or some other upper level approved course for 44.496.

44.490 CJ Research Honors Seminar*

Note: This course is recommended for those who plan to further their careers in graduate school. Others may take another upper level course.

A minimum of seven additional Criminal Justice courses are required. Two of these must be at the 300 or 400 level.

In addition please note that from among all electives, either collateral or free electives, that the student presents for graduation, at least two must be at the 300 or 400 level. A 2.0 cumulative average overall and a 2.2 average in the major are necessary for graduation.

2. Skills Requirement

Students majoring in the Administration of Criminal Justice are required to meet proficiency standards in one of the following:

Intermediate Proficiency in a modern Foreign Language, preferably Spanish. (Students should consult policies in the University Catalog under the heading of University Academic Policies: Language requirement for a list of avenues by which certification of language proficiency may be pursued.) or Computer and Statistics, proficiency to be demonstrated by passing a minimum of four courses (12 credits) from the following approved list:

- 1. 44.201 Computer Applications in Criminal Justice

91.111 Everyday Computing

91.115 Developing Database Applications OR

91.114 Advanced Internet

2. 91.113 Exploring the Internet

3. 44.395 Statistics in Criminal Justice

92.183 Introduction to Statistics or

92.283 Statistics For Behavioral Science

4. 44.398 Data Analysis in Criminal Justice

92.363 Data Analysis or

43.335 Quantitative Methods

There is no prohibition against completing both options in the professional skills area. Students who fulfill the requirements of either the minor in mathematics with the computer science option, or the requirement for the certificate in proficiency offered by the Mathematics Department will automatically fulfill the skills requirement.

3. Collateral Requirements

In addition to the major courses and the professional skills area, the student majoring in the administration of Criminal Justice will select six courses from an approved list of correlative courses. Courses used to fulfill the professional skills requirement may be used toward fulfillment of this requirement. The following is a list of suggested correlative courses from which criminal justice majors may choose:

41.261 Introduction to Legal Concepts

41.262 Introduction to Business Law

41.363 Corporate and Property Law

41.369 Courts and Constitution

41.376 Family Law

41.381 Women in the Law

42.382 Crime in Literature

43.216 American Urban History I

43.217 American Urban History II

43.268 History of Family and Childhood in the U.S.

43.308 History of Crime, Conflict, and Social Control in U.S.

43.335 Quantitative Methods in History and Social Science

- 43.349 English Constitution and Legal History
- 45.203 Introduction to Ethics
- 46.105 Introduction to Public Policy
- 46.202 Practical Public Affairs
- 46.265 State and Local Politics
- 46.270 Legislative Politics
- 46.345 Constitutional Law and Politics
- 46.347 Civil Liberties, Law and Politics
- 46.355 Government Fiscal Policy
- 46.356 Public Policy Analysis
- 46.360 Public Administration
- 46.410 Reading Seminar in Judicial Review
- 47.163 Human Life Span
- 47.209 Social Psychology
- 47.232 Psychology of Personality
- 47.260 Human Development I
- 47.272 Abnormal Psychology
- 47.360 Human Development II
- 47.364 Psychology of Crime and Corrections
- 48.231 Sociology of Family
- 48.234 Study of Minorities
- 48.235 Black Experience in American Life
- 48.255 Sociology of Deviance
- 48.256 Political Sociology
- 48.341 Social Stratification
- 48.345 Urban Sociology
- 48.361 Sociology of Law
- 48.402 Social Research
- 91.113 Exploring the Internet
- 92.183 Introduction to Statistics
- 92.263 FORTRAN Programming
- 92.256 Pascal
- 92.363 Data Analysis

All courses in the Criminal Justice major are regarded as professional courses and are not accepted either in transfer or as elective options in other degree programs in the College of Arts and Sciences.

Students who transfer to the Criminal Justice Major or to the College of Arts and Sciences with the intention of subsequently declaring this major must make individual arrangements with the Department chairperson regarding satisfaction of minor and collateral course requirements.

For the student wishing to prepare him or herself as completely as possible, the University of Massachusetts Lowell is particularly well suited for providing the student with a Mathematics Minor-Computer Option, a carefully selected arrangement of courses from the College of Management, the opportunity for a second major in Political Science, Psychology, Sociology, or any other field of study offered by the University. (See the University catalog for regulations of the College of Arts and Sciences offered governing minors.)

Criminal Justice Courses (Prefix: 44)

44.101 The Criminal Justice System
A brief history of the Criminal Justice System and an analysis of its structure and function. This course is required of all CJ majors and is a prerequisite for all other courses in criminal justice. (3,0)3

44.141 Police Process
Examination of the historical development of police work with special emphasis on the conflicting role expectations facing the police officer. (3,0)3

44.111 Introduction to Industrial Security
An introduction to the planning, organization, and management of Industrial businesses, and government security resources. The focuses is on the protection of assets via the integration of physical, personal, and information security. Relations between security organizations and government agencies are also explored. (3,0)3

44.201 Computer Applications in Criminal Justice
An introduction to the use and application of computers and computer programs in word processing, data processing, and spreadsheet applications as they pertain to the field of criminal justice. By the end of this course, students will be able to utilize all three applications. This is a laboratory course. (3,0)3

44.241 Physical Security
The basic principles of physical security, with emphasis on tailoring these principles to the protection of specific operations and facilities. Proper planning, appropriate design, and use of modern techniques and devices to enhance security while reducing costs are discussed. (3,0)3

44.221 Criminology
The definition and nature of crime, criminal statistics, and theories of crime causation are included. Required of all CJ majors. (3,0)3

44.233 Criminal Procedure
The workings of the legal system as they pertain to the criminal justice professional. Particular emphasis is placed on police, pretrial, and trial procedures. (3,0)3

44.234 Criminal Law
The historical origins and development of criminal law from the early common law to contemporary decisions and statutes. Constitutional and statutory factors as they pertain to criminal responsibility, capacity, crimes against persons and property, defenses to criminal charges and sentences. Sections of the Massachusetts Criminal Code and other statutes will be covered where applicable. (3,0)3

44.241 Principles of Investigation
Examination of criminal investigation process, focusing on substantive areas such as arson, larceny, sexual offenses, forgery and fraud. Also discussed are issues of investigative priorities, fiscal restraint, and informational management. (3,0)3

44.243 Criminalistics I
This laboratory course will cover basic procedures in arrest, search and seizure, and the gathering and evaluation of evidence as to admissibility, weight and competence. (3,0)3

44.247 Federal Law Enforcement
This course is designed to provide students with an overview of the structures and functions of Federal Law Enforcement Agencies. The course will integrate field and professional experience with case studies into an academic framework. (3,0)3

44.251 Institutional Corrections

Detailed examination of the U.S. prison and jail systems, highlighting such issues as classification of offenders, crowding, treatment programs, prison violence, and privatization. (3,0)3

44.261 Juvenile Delinquency

An examination of Causative factors in the development of youthful offenders and the development and philosophy behind treatment and rehabilitative practices. (3,0)3

44.321 Advanced Criminology

An examination of theories of criminal behavior, both historical and contemporary, and their impact on the evolution of punishment, treatment, and rehabilitative practices. Prerequisite: 44.221 (3,0)3

44.322 Crime Prevention

Explores the growth of crime prevention as an alternative to criminal justice responses to crime and examines current theories and research on different approaches to preventing crime, including developmental, situational, and community prevention. (3,0)3

44.326 Hate Crime

The issue of hate crime is examined, focusing on federal and state statutory laws and the dynamics of police, court, and corrections based responses to the problem. (3,0)3

44.331 Penal Law

A study of the constitutional rights of individuals, including major policy issues and trends associated with revisions of penal codes. (3,0)3

44.335 Juvenile Justice

An examination of the civil procedures used in juvenile court as opposed to the adversarial procedures used in criminal court, together with a history of the development of the juvenile court and an examination of its constitutional basis. Prerequisite: 44.234. (3,0)3

44.341 International Perspectives on Crime and Crime Control

An introduction to international perspectives on crime and crime control policy in Western countries. International developments and cross national research on crime and victimization, criminal justice, and crime prevention policy, and current issues will be examined. (3,0)3

44.347 Community Policing

An examination of community policing models, application issues, and contemporary research on community policing. (3,0)3

44.351 Community Based Corrections

A comprehensive review of community based sanctions and community based early release mechanisms. In addition to traditional probation and parole reviews "new" intermediate sanctions, such as electronic monitoring, intensive supervision, bootcamps, day fines, day reporting centers, and community service centers. (3,0)3

44.360 Gender, Race and Crime

The gender and racial implications of criminal laws, criminal justice practices and programs will be examined. The position of women and racial/ethnic minorities will be assessed from the different perspectives of victims, offenders, and criminal justice practitioners. Prerequisites: 44.234, 46.345, or 46.347 (3,0)3

44.370 Criminal Justice Management

An introduction to the principles of administration, including planning, budgeting, grantsmanship, and evaluation as they relate to the criminal justice manager. (3,0)3

44.371 Criminal Justice Planning

A continuation of Criminal Justice Management with a particular emphasis placed upon student design and evaluation of programs and plans. (3,0)3

44.372 Issues in Correctional Administration

Specific analysis of the management of correctional institutions including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining, community relations, and other related issues. Prerequisite: 44.370 or equivalent (3,0)3

44.373 Issues in Police Administration

Specific analysis of the management of contemporary police forces, including staffing, scheduling, training, collective bargaining, community relations and other related issues. Prerequisite: 44.370 or equivalent (3,0)3

44.380 Selected Issues in Criminal Justice

An advanced course of study and examination of a variety of current issues and

topics in criminal justice. Students without a sufficient background in criminal justice courses should not attempt this course. (3,0)3

44.382 Privatization of Criminal Justice

This course examines the rationales, the characteristics, and the effects of the privatization movement in criminal justice. Particular emphasis is placed on privatization of police and prisons. (3,0)3

44.383 Law and Social Control

This course compares and contrasts the use of criminal and civil law mechanisms of social control. Substantive areas examined include mental illness, drug addiction, and alcoholism. (3,0)3

44.385 Crime and Mental Illness (eve school offering)

A consideration of the realities and myths surrounding the relationship between mental illness and crime. Material from criminal justice and psychology will be examined. (3,0)3

44.386 Social Psychology of the Criminal Justice System

The application of social psychological principles, research & theories to issues of the CJ system. There is an emphasis on areas including social influence, decision making, bystander intervention, collective behavior, rumor in crisis, aggression and violence. (3,0)3

44.390 Introduction to Criminal Justice Research

An introduction to research methods for the criminal justice professional including terminology, standard methodologies, and elementary statistics. (3,0)3

44.395 Statistics in Criminal Justice

This course is an extension of concepts learned in 44.390 (Introduction to Criminal Justice Research Methods). Statistics will be utilized as a mathematical "language" for interpreting the interrelation of social forces impacting criminality and deviance. The course will focus on how various statistics are calculated, but more importantly, the meaning of these figures for criminal justice scholars and practitioners will be discussed. (3,0)3

44.398 Methods of Data Analysis

The student is introduced to computer software packages (i.e. SPSS) used to analyze large quantitative data sets common

in criminal justice/criminology. This course is seen as the capstone to the research methods/technology component of the major, and is intended for upper-level students, especially those preparing for graduate study. (3,0)3

44.401 Substance Abuse and Crime
Covers the problems posed by drugs and drug use/abuse and examines how the law is used to deal with those problems. (3,0)3

44.406 Directed Study (3,0)3
44.411 Technology and Crime Prevention

Examines issues and principles involved in crime prevention through the use of proven and innovative design of various aspects of physical security. (3,0)3

44.412 Issues in Security Administration

This course is a continuation of 44.312 Security Management, and as such, will explore in greater depth those problems and issues in planning, budgeting, organizing, staffing, directing, and controlling security operations. (3,0)3

44.422 Victimology

Examines the patterns of victimization, the characteristics and lifestyles of crime victims and the impact of their victimizations. The treatment of victims by the criminal justice system will be examined along with possible reforms in these approaches. (3,0)3

44.423 Elite Deviance and Crime
Examines the systematic violation of the laws and ethics of business and politics. The structure of power and privilege in relation to both political and economic deviance will be major topics. The impact of corporate crime and deviance on society and the societal and legal reactions will be explored. Prerequisite: 44.221 (3,0)3

44.435 Alternative Dispute Resolution (3,0)3

44.477 Domestic Violence (3,0)3
Examines the causes and consequences of domestic violence and the latest research regarding the responses of the criminal justice system. (3,0)3

44.478 Child Maltreatment

Provides an overview of the criminal and non-criminal victimizations that occur to children and adolescents in the United States and elsewhere. Topics examined

include the theories of and risk factors associated with child maltreatment, the physical and psychological consequences, and the response to child maltreatment by the criminal justice system and other agencies and organizations. (3,0)3

44.490 Criminal Justice Research Honors Seminar

Specific practice in the definition, design, and execution of a research project, and an analysis of the impact of contemporary criminal justice research on policy development. Prerequisite: 44.390. (3,0)3

44.393 Computer Crime and Security

An examination of the causes and consequences of computer crime as well as the criminal justice system's response to the problem. (3,0)3

44.496 Practicum

Assigned fieldwork under the supervision and with the permission of the instructor assigned to the course. The purpose is to broaden the educational experience of pre-service students in law enforcement, probation, and correctional agencies within this area. This course is designed to provide a correlation of theoretical knowledge with practical experience in an area of particular interest to the student. (3,0)3

Program Tracks

The following tracks are offered as a suggestion. Students who do not wish to follow a specific track are under no obligation to do so.

Enforcement

Suggested Courses:

44.101 The CJ System

44.141 Police Process

44.201 Computer App. CJ

44.221 Criminology

44.233 Criminal Procedure

44.234 Criminal Law

44.243 Criminalistics

44.244 Criminalistics II

44.247 Federal Law Enforcement

44.261 Juvenile Delinquency

44.341 Comparative Criminal Justice

44.347 Community Policing

44.370 CJ Management

44.373 Issues in Police Admin.

44.390 Intro to CJ Research

44.490 CJ Research Seminar

44.494 Field Seminar and

44.495 Field Internship or

44.496 Practicum

Law and the Courts

Suggested Courses:

44.101 The CJ System

44.221 Criminology

44.201 Computer App. CJ

46.230 Law and the Legal System

44.233 Criminal Procedure

44.234 Criminal Law

44.261 Juvenile Delinquency

44.321 Advanced Criminology

44.331 Penal Law

44.335 Juvenile Justice

44.360 Gender, Race, and Crime

44.370 CJ Management

44.371 CJ Planning

44.390 Intro to CJ Research

44.490 CJ Research Seminar

44.494 Field Seminar and

44.495 Field Internship or

44.496 Practicum

Corrections

Suggested Courses:

44.101 The CJ System

44.251 Institutional Corrections

44.201 Computer App. CJ

44.201 Criminology

44.233 Criminal Procedure

44.234 Criminal Law

44.331 Penal Law

44.341 Comparative Criminal Justice

44.351 Community Based Corrections

44.370 CJ Management

44.371 CJ Planning

- 44.372 Issues in Corr. Admin.
- 44.390 Into to CJ Research
- 44.490 CJ Research Seminar
- 44.494 Field Seminar and
- 44.495 Field Internship or
- 44.496 Practicum

Security Management

Suggested Courses:

- 44.101 The CJ System
- 44.111 Industrial Security
- 44.201 Computer App. CJ
- 44.211 Physical Security
- 44.211 Criminology
- 44.233 Criminal Procedure
- 44.234 Criminal Law
- 44.312 Security Management
- 44.411 Crime Prevention via
Environmental Design
- 44.412 Issues in Security Administration

Department of Environmental, Earth, and Atmospheric Sciences

Arnold L. O'Brien, Chairperson

Professors: Frank P. Colby, Jr., Robert C. Curtis (Emeritus), G. Nelson Eby, Robert R. Gamache, Arnold L. O'Brien, Bodo W. Reinisch, Wen Tang (Emeritus)

Associate Professors: Dan S. Golomb, Richard Z. Gore

Department Location: Olney Hall, Room 301

Telephone: (978) 934-3900

The Department of Environmental, Earth, and Atmospheric Sciences offers programs of study which provide a firm base in science and mathematics and a broad understanding of the natural environment. The programs are multidisciplinary in approach, and the composition of the faculty, geologists, geophysicists, chemists and meteorologists, reflects this multidisciplinary character. Three program concentrations are offered within the Bachelor of Science degree in Environmental Science: Atmospheric Science, Environmental Studies, and Geoscience. The aim of the program is to successfully prepare students for graduate school and for careers in research labs, industry, consulting and weather forecasting firms, and state and federal governmental agencies such as DEP and EPA. All the concentrations were founded more than 20 years ago and graduates of the program have achieved considerable success in the environmental and meteorological fields. Internships are available with many private and governmental organizations. These provide the student with practical experience and potential entry into the job market. Undergraduate research is also encouraged and students in the department are active participants in the University's Honors Program.

The department has over 30 PC, Macintosh, and Unix based computer systems and work stations and a wide variety of software applications and languages, such as air-pollution and weather models, FORTRAN and C/C++ compilers,

Mathematica and Maple computer mathematics systems. Geographic Information Systems (e.g. Arc View, Map Information, IDRISI etc.) word-processing, spreadsheets and databases are available. Also housed in the department is a weather center with Internet links and remote observation platforms, an air pollution laboratory, a chemistry laboratory for environmental analysis, an instrumental neutron activation analysis laboratory used to measure trace constituents in natural samples, and a fission-track geochronology laboratory, and a geographic information systems laboratory. In addition, faculty in the department are affiliated with the Center for Atmospheric Research, the Center for Environmental Engineering and Science, and the Radiation Laboratory, and maintain active collaborations with other universities and research facilities.

There are a number of student organizations in the department. The student chapter of the American Meteorological Society, a national organization, serves as a focal point for those students interested in the atmospheric sciences. The Society of Environmental Scientists encompasses students interested in a broad range of environmental activities and issues. Sigma Gamma Epsilon is a national earth science honorary society open to all qualified students. These student organizations sponsor speakers, organize field trips, and provide career and job placement seminars.

The department also provides core courses for the University's general education program encouraging intellectual inquiry into the critical issues of the earth and the environment. Such courses recognize the fact that the understanding of environmental processes is fundamental to ecologically sound and sustainable development in a variety of fields.

Bachelor of Science in Environmental Science

The major in Environmental Science is a broad-based interdisciplinary program designed to provide students with an understanding of the complex interrelationships which exist between the lithosphere, hydrosphere, biosphere, and atmosphere. A basic understanding of science and mathematics is fundamental to

the program, and all concentrations require one year sequences in physics, chemistry, and calculus, plus additional science and mathematics courses as appropriate for the particular concentration. A three course sequence (Principles of Earth & Environmental Systems I & II and Environmental Geochemistry) provides an integrated understanding of the behavior of natural systems, a preliminary step to more focused study of a particular aspect of the natural environment. The program diverges at this point with students interested in the atmospheric environment and meteorology following the Atmospheric Science Concentration, those interested in the geologic environment following the Geoscience Concentration, and those interested in both the scientific and social aspects of environmental problems following the Environmental Studies Concentration.

The degree program also provides the basic course work, with a few additional courses required depending on the concentration, for students who wish to pursue a career in earth science teaching. For students interested in this career path, the College of Education offers a graduate degree program designed to prepare elementary and secondary teachers in earth sciences. This year-long program (September to June) provides the course work and the apprentice teaching experience required for certification in Massachusetts and thirty-three other states (see the Graduate Catalogue for admission requirements). Additional information may be obtained from the College of Education.

Atmospheric Science Concentration

The Atmospheric Science concentration focuses on meteorology, but also includes components dealing with atmospheric physics and chemistry, solar-terrestrial and ocean-atmosphere interactions, air pollution and air pollution control, and global climate change due to man-made emissions. The goal of the program is to provide students with the knowledge of the fundamental principles and techniques of physics and mathematics which are necessary for understanding atmospheric behavior and for solving practical prob-

lems concerning weather, climate and air pollution. Because atmospheric science is primarily the application of the principles and techniques of physical sciences to the study of the atmosphere, the curriculum specifies a substantial core of supporting science and mathematics courses.

Historically, meteorology has been the primary employment field for graduates of this concentration. The meteorologist studies the physical causes of weather and climate and applies this knowledge to the solution of practical problems, ranging from the forecasting of weather to the analysis of the influence of weather and climate on public health, agriculture, engineering, industry and commerce, and national defense. The more broadly trained atmospheric scientist will also find opportunities in the fields of air pollution research and control. Meteorologists and Atmospheric Scientists are employed by the agencies of the federal government, the National Oceanic and Atmospheric Administration, the National Weather Service, and the Department of Defense, as well as by agencies of state and local governments, and by commercial aviation companies and private consulting firms.

A significant number of students who graduate from this concentration continue their education by attending graduate school. Atmospheric Science majors who wish to continue their studies at the graduate level are advised to develop competencies in science and mathematics, especially in computer science, beyond the required science and mathematics core.

Environmental Studies Concentration

The field of environmental science is interdisciplinary in nature. This concentration blends a strong science core with focused areas in the humanities/social sciences leading to a program of study that is compatible with the student's strengths and goals. The science focus can be in either biology or chemistry. The choice of a humanities/social sciences focus will depend on the student's interests.

This concentration prepares the student for employment in the private and government sector, where knowledge is required in management and protection of the envi-

ronment, environmental laws and regulations, natural resources, and environmental economics. Graduates of this concentration can have a variety of career experiences. Several are doctors and environmental lawyers. Some are teachers. Others work as environmental analysts, planners, water treatment plant operators, hydrological consultants, noise and air pollution specialists, and as managers in private industry and government. This concentration will also prepare the student for graduate work in environmental science.

Geoscience Concentration

This concentration is aimed at students who have an interest in the physical environment, but desire a broader preparation than that of the traditional geology major. The concentration is centered around a strong geoscience core, but includes additional course work in the biological sciences, hydrogeology and hydrochemistry, and geographical information systems. Thus the student will not only be preparing for entry into the traditional areas of geological employment (petroleum and mining) but also for the expanding opportunities in hydrogeology, hazardous waste assessment and management, groundwater remediation, wetlands delineation and evaluation, and environmental management. This concentration is also recommended for students who might wish to obtain certification as earth science teachers.

Graduates of this concentration are qualified for a number of different types of employment opportunities. Previous graduates have found employment in the petroleum industry, in asbestos identification and remediation, as analytical specialists in environmental testing laboratories, and in the field evaluating hazardous waste sites and ground and surface water contamination. This concentration also provides the requisite course work for students who wish to pursue a graduate degree in environmental science or geology.

Degree Requirements for Atmosphere Science Concentration

I. General Education Requirements (24 credit)

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
College Writing	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts, and Choice	3 cr
[87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.]	

II. Major Field Requirements (93 credit)

A. Environmental Science I 3 cr

87.101 Environmental Science Seminar	1 cr
87.201 Prin. of Earth & Envir. Systems I	4 cr
87.202 Prin. of Earth & Envir. Systems II	4 cr
89.315 Environmental Geochemistry	4 cr

B. Atmospheric Science 43 cr

85.102 Weather Forecasting Seminar	1
85.302 Atmospheric Dynamics	3
85.304 Methods in Meteorology I	3
85.305 Methods in Meteorology II	3
85.306 Environmental Problem Solving3	
85.308 Forecasting and Synoptic Tech. I	3
85.309 Forecasting and Synoptic Tech. II	3
85.315 Advanced Atmospheric Dynamics I	3
85.316 Advanced Atmospheric Dynamics II	3
85.403 Physical Meteorology	3
85.483 Solar-Terrestrial Relations	3
85.571 Air Pollution Phenomenology	3

Atmospheric Science Electives

Select three of the following:

85.313 Physical Climatology	3
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85.340 Tropical Meteorology	3
85.350 Satellite and Radar Meteorology	3
85.360 Upper Atmosphere Meteorology	3
85.410 Advanced Forecasting	3
85.523 Air Pollution Control	3
C. Supporting Sciences and Mathematics 37 cr	
92.131 Calculus I	4 cr
92.132 Calculus II	4 cr
92.231 Calculus III	4 cr
92.234 Differential Equations	3 cr
92.263 FORTRAN Programming	3 cr
92.386 Statistics for Sci & Eng	3 cr

95.103 General Physics I	3 cr
96.103 Experimental General Physics I	1 cr
95.104 General Physics II	3 cr
96.104 Experimental General Physics II	1 cr

84.121 Chemistry I	3 cr
84.123 Chemistry I Lab	1 cr
84.122 Chemistry II	3 cr
84.124 Chemistry II Lab	1 cr

III. Unrestricted Elective Courses (34 credits)

IV. Minimum 120 Credit Requirements

Degree Requirements for Environmental Studies Concentration

I. General Education Requirements (24 credits)

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
College Writing	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts, and Choice	3 cr
[87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.]	

II. Major Field Requirements (93-95 credits)

A. Environmental Science 24 cr

81.315 Principles of Ecology	2 cr
81.317 Principles of Ecology Lab	2 cr
87.101 Environmental Science Seminar	1 cr
87.102 Environmental Problems Seminar	1 cr
87.201 Prin. of Earth & Envir. Systems I	4 cr
87.202 Prin. of Earth & Envir. Systems II	4 cr
87.406 Geographic Information Systems	3 cr
89.314 Hydrogeology	3 cr
89.315 Environmental Geochemistry	4 cr

B. Science Focus 14-16 cr

Majors in the Environmental Studies concentration must take a minimum of four courses (14 or more semester credits) from one of the following two categories. In addition to the courses listed below other courses may be substituted with the permission of the department program committee.

1. Biology

81.201 General Microbiology	3 cr
81.203 General Microbiology Lab	1 cr
81.215 Introduction to Marine Biology	3 cr
81.217 Introduction to Marine Biology Lab	1 cr

81.224 Intro to Insect Biology	3 cr
81.226 Intro to Insect Biology Lab	1 cr
81.306 Invertebrate Zoology	3 cr
81.308 Invertebrate Zoology Lab	1 cr
81.320 Botany	3 cr
81.322 Botany Lab	1 cr
81.335 Principles of Genetics	3 cr
81.337 Principles of Genetics Lab	1 cr
81.342 Comparative Vertebrate Anatomy	3 cr
81.344 Comparative Vertebrate Anatomy Lab	1 cr

2. Chemistry

84.207 Inorganic Chemistry	3 cr
84.209 Inorganic Chemistry Lab	1 cr

84.221 Organic Chemistry I	3 cr
84.227 Organic Chemistry I Lab	1 cr
84.222 Organic Chemistry II	3 cr
84.228 Organic Chemistry II Lab	1 cr
84.324 Principles of Analytical Chemistry	3 cr
84.325 Prin. of Analytical Chemistry Lab	1 cr
84.344 Physical Chemistry I	3 cr
84.346 Physical Chemistry I Lab	1 cr
84.345 Physical Chemistry II	3 cr
84.347 Physical Chemistry II Lab	1 cr

C. Humanities/Social Science Focus 18 cr

Majors in the Environmental Studies concentration must take a minimum of six courses (18 or more semester credits) from one of the following categories. Students must follow the prescribed program in each category. In addition to the courses listed below other courses may be substituted with the permission of the department program committee.

1. Economics

Required courses:

49.201 Economics I	3 cr
49.202 Economics II	3 cr
49.315 Intro. to Environmental Economics	3 cr

Select 3 courses from the following list:

49.303 Microeconomic Theory	3 cr
49.304 Macroeconomic Theory	3 cr
49.310 Eco. of Less Developed Countries	3 cr

49.328 Eco. of Energy and the Environment	3 cr
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49.329 Environ. Cost-Benefit Analysis	3 cr
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41.367 Environmental Law	3 cr
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46.357 Science, Tech., and Public Policy	3 cr
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2. English (communication)

42.222 Oral Communication	3 cr
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42.225 Basic Technical Writing	3 cr
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42.226 Tech. and Scientific Comm.	3 cr
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42.229 Essay Writing for Non-majors	3 cr
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42.300 Intro to Journalism	3 cr
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42.309 Augmentation and Research Skills	3 cr
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42.324 Writing About Nature and the Env.	3 cr
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42.383 Literature and Science	3 cr
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42.387 Editing and Publishing Techniques	3 cr
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42.390 Technical and Scientific Writing	3 cr
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42.450 Writing Workshop	3 cr
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3. Legal Studies

Required Course:

41.367 Environmental Law	3 cr
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Select 5 courses from the following list:

41.262 Business Law	3 cr
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41.363 Corporate and Property Law	3 cr
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41.365 The Legal Environment of Business	3 cr
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41.366 International Law	3 cr
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41.370 Real Estate Law	3 cr
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41.379 The Rel. of Law, Logic and Ethics	3 cr
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41.386 Intellectual Property	3 cr
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41.387 Legal Research Methods	3 cr
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4. Modern Languages

Six courses in one of the following languages: French, Italian, or Spanish

5. Political Science

Required courses:

46.101 Introduction to American Politics	3 cr
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46.357 Environmental Policy	3 cr
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Select 3 courses from the following list:

46.105 Introduction to Public Policy	3 cr
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46.205 Introduction to Political Economy	3 cr
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46.335 State, Bureaucracy and Policy	3 cr
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46.338 Political Participation	3 cr
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46.340 Seminar in American Politics	3 cr
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46.352 Science, Tech. and Public Policy	3 cr
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Select 1 course from the following list:

46.265 Intro. to State and Local Gov.	3 cr
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46.343 The Congress	3 cr
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46.350 Urban Politics and Policy	3 cr
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46.353 Public Admin. and Public Policy	3 cr
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46.378 International Political Economy	3 cr
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D. Supporting Sciences and Mathematics 37 cr

92.131 Calculus I	4 cr
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92.132 Calculus II	4 cr
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92.183 Intro to Statistics or	3 cr
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92.386 Statistics for Sci & Eng	
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95.103 General Physics I	3 cr
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96.103 Experimental General Physics I	1 cr
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95.104 General Physics II	3 cr
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96.104 Experimental General Physics II	1 cr
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84.121 Chemistry I	3 cr
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84.123 Chemistry I Lab	1 cr
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84.122 Chemistry II	3 cr
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84.124 Chemistry II Lab	1 cr
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81.111 Principles of Biology I	3 cr
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81.113 Principles of Biology I Lab	2 cr
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81.112 Principles of Biology II	3 cr
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81.114 Principles of Biology II Lab	2 cr
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III. Unrestricted Elective Courses (1-3 credits)

IV. Minimum 120 Credit Requirement

Degree Requirements For Geoscience Concentration

I. General education Requirements (24 credits)

Aesthetics	3 cr
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Behavioral and Social Sciences	6 cr
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College Writing	6 cr
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Historical Studies	3 cr
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Literature	3 cr
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Values, Concepts, and Choice	3 cr
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[87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.]

II. Major Field Requirements (94 credits)

A. Environmental Science 24 cr

81.315 Principles of Ecology	2 cr
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81.317 Principles of Ecology Lab	2 cr	92.183 Intro to Statistics or	3 cr	89.352 Sedimentation & Stratigraphy	3 cr
87.101 Environmental Science Seminar	1 cr	92.386 Statistics for Sci & Eng		89.354 Sedimentation & Stratigraphy Lab	1 cr
87.102 Environmental Problems Seminar	1 cr	95.103 General Physics I	3 cr	89.356 Applied Geophysics	3 cr
87.201 Prin. of Earth & Environ. Systems I	4 cr	96.103 Experimental General Physics I	1 cr	89.452 Advanced Geochemistry	3 cr
87.202 Prin. of Earth & Environ. Systems II	4 cr	95.104 General Physics II	3 cr	89.514 Regional Hydrogeology	3 cr
87.406 Geographic Information Systems	3 cr	96.104 Experimental General Physics II	1 cr		
89.314 Hydrogeology	3 cr	84.121 Chemistry I	3 cr	Sample Course of Study for Atmospheric Science Concentration Freshman Year Fall Semester	
89.315 Environmental Geochemistry	4 cr	84.123 Chemistry I Lab	1 cr		
B. Geoscience 33 cr		84.122 Chemistry II	3 cr		
89.201 Principles of Geology	3 cr	84.124 Chemistry II Lab	1 cr		
89.203 Principles of Geology Lab	1 cr	81.111 Principles of Biology I	3 cr		
89.301 Mineralogy & Crystallography	3 cr	81.113 Principles of Biology I Lab	2 cr	42.101 College Writing (Gen Ed)	3
89.303 Mineralogy & Crystallography Lab	1 cr	81.112 Principles of Biology II	3 cr	84.121 Chemistry I	3
89.304 Igneous & Metamorphic Petrology	3 cr	81.114 Principles of Biology II Lab	2 cr	84.123 Chemistry I Lab	1
89.306 Igneous & Metam. Petrology Lab	1 cr	III. Unrestricted Elective Courses (2 credit)		87.101 Environmental Science Seminar	1
89.316 Geomorphology	3 cr	IV. Minimum 120 Credit Requirement		92.131 Calculus I	4
89.318 Geomorphology Lab	1 cr	Geoscience Minor		95.103 General Physics I	3
89.322 Structural Geology	3 cr	A minor in Geoscience consists of 87.201 Principles of Earth & Environmental Systems I and 87.202 Principles of Earth & Environmental Systems II and four courses (plus any corequisite laboratories) from the following list. All course prerequisites and corequisites must be satisfied.		96.103 General Physics I Lab	1
89.324 Structural Geology Lab	1 cr	89.201 Principles of Geology	3 cr		16
89.326 Glacial & Pleistocene Geology	3 cr	89.203 Principles of Geology Lab	1 cr	Spring Semester	
89.352 Sedimentation & Stratigraphy	3 cr	89.301 Mineralogy & Crystallography	3 cr	42.102 College Writing II (Gen Ed)	3
89.354 Sedimentation & Stratigraphy Lab	1 cr	89.303 Mineralogy & Crystallography Lab	1 cr	84.122 Chemistry II	3
Geoscience electives	6 cr	89.304 Igneous & Metamorphic Petrology	3 cr	84.124 Chemistry II Lab	1
Select two of the following:		89.306 Igneous & Metam. Petrology Lab	1 cr	85.102 Weather Forecasting Seminar	1
89.452 Advanced Geochemistry	3 cr	89.314 Hydrogeology	3 cr	92.132 Calculus II	4
89.356 Applied Geophysics	3 cr	89.315 Environmental Geochemistry	4 cr	94.104 General Physics II	3
89.524 Regional Hydrogeology	3 cr	89.316 Geomorphology	3 cr	96.104 General Physics Lab II	1
		89.318 Geomorphology Lab	1 cr		16
C. Supporting Sciences and Mathematics 37 cr		89.322 Structural Geology	3 cr	Sophomore Year	
92.131 Calculus I	4 cr	89.324 Structural Geology Lab	1 cr	Fall Semester	
92.132 Calculus II	4 cr	89.326 Glacial & Pleistocene Geology	3 cr	87.201 Earth and Environmental Systems I	4
				85.306 Environmental Problem Solving	3
				92.231 Calculus III	4
				91.263 FORTRAN Programming	3
					14
				Spring Semester	
				87.202 Earth and Environmental Systems II	4
				92.234 Differential Equations	3

93.386	Statistics for Sci & Eng	3
	Aesthetics Gen Ed Elective	3
	History Gen Ed Elective	3

16

Junior Year**Fall Semester**

85.304	Methods in Meteorology I	3
	Atmospheric Science Elective	3

89.315	Environmental Geochemistry	4
	Behavioral Gen Ed Elective	3
	Gen Ed Elective	3

16

Spring Semester

85.305	Methods in Meteorology II	3
85.301	Atmospheric Dynamics	3
	Atmospheric Science Elective	3
	Literature Gen Elective	3
	Values Gen Ed Elective	3

15

Senior Year**Fall Semester**

85.308	Forecasting and Synoptic Tech I	3
85.403	Physical Meteorology	3
85.415	Advanced Atmospheric Dynamics I	3
	Atmospheric Science Elective	3
	Open Elective	3

15

Spring Semester

85.309	Forecasting & Synoptic Tech II	3
85.416	Advanced Atmospheric Dynamics II	3
85.571	Air Pollution Phenomenology	3
85.483	Solar-Terrestrial Relations	3

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Sample Course of Study For Environmental Studies Concentration**Freshman Year****Fall Semester**

42.101	College Writing I (Gen Ed)	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
87.101	Env. Science Seminar	1
	Gen Ed Elective	3

15

Spring Semester

42.102	College Writing II (Gen Ed)	3
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.132	Calculus II	4
87.102	Env. Problems Seminar	1
	Gen Ed Elective	3

15

Sophomore Year**Fall Semester**

87.201	Earth & Env. Systems I	4
95.103	General Physics I	3
96.103	Exp. General Physics I	1
81.111	Principles of Biology I	3
81.113	Prin. of Biology I Lab	2
	Mathematics Elective	3

16

Spring Semester

87.202	Earth & Env. Systems II	4
95.104	General Physics II	3
96.104	Exper. General Physics II	1
81.112	Principles of Biology II	3
81.114	Prin. of Biology II Lab	2
	Gen Ed Elective	3

16

Junior Year**Fall Semester**

89.315	Env. Geochemistry	4
	Science Focus Elective	4
	Hum/Soc Focus Elective	3

Gen Ed Elective	3
	14

Spring Semester

89.314	Hydrogeology	3
	Science Focus Elective	3
	Hum/Soc Focus Elective	3
	Hum/Soc Focus Elective	3
	Gen Ed Elective	3

15

Senior Year**Fall Semester**

81.315	Free Elective	2
81.317	Principles of Ecology Lab	2
	Science Focus Elective	4
	Hum/Soc Focus Elective	3
	Gen Ed Elective	3

14

Spring Semester

87.406	Principles of Ecology	2
	Science Focus Elective	3
	Hum/Soc Focus Elective	3
	Hum/Soc Focus Elective	3
	Free Elective	3

15

Sample Course of Study For Geoscience Concentration**Freshman Year****Fall Semester**

42.101	College Writing I (Gen Ed)	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
87.101	Env. Science Seminar	1
	Gen Ed Elective	3

15

Spring Semester

42.102	College Writing II (Gen Ed)	3
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.132	Calculus II	4
87.102	Env. Problems Seminar	1

Gen Ed Elective 3
15

Sophomore Year**Fall Semester**

87.201 Earth & Environmental Systems I 4
95.103 General Physics I 3
96.103 Exper. General Physics I 1
81.111 Principles of Biology I 3
81.113 Prin. of Biology I Lab 2
Mathematics Elective 3
16

Spring Semester

87.202 Earth & Environmental Systems II 4
95.104 General Physics II 3
96.104 Exper. General Physics II 1
81.112 Principles of Biology II 3
81.114 Prin. of Biology II Lab 2
Gen Ed Elective 3
16

Junior Year**Fall Semester**

89.201 Principles of Geology 3
89.203 Principles of Geology Lab 1
89.301 Miner. & Crystallography 3
89.303 Mineralogy & Crystal. Lab 1
89.315 Envir. Geochemistry 4
Gen Ed Elective 3
15

Spring Semester

89.304 Igneous & Metamorphic Petrology 3
89.306 Igneous & Metamorphic Petrology Lab 1
89.314 Hydrogeology 3
89.316 Geomorphology 3
89.318 Geomorphology Lab 1
Geoscience Elective 3
Gen Ed Elective 3
17

Senior Year**Fall Semester**

81.315 Free Elective 2
81.317 Principles of Ecology Lab 2
89.322 Structural Geology 3
89.324 Structural Geology Lab 1
Geoscience Elective 3
Gen Ed Elective 3
14

Spring Semester

87.406 Principles of Ecology 2
89.326 Glacial & Pleistocene Geology 3
89.352 Sedimentation & Stratigraphy 3
89.354 Sedimentation & Strat. Lab 1
Free Elective 3
13

Atmospheric Science Courses (Prefix:85)**85.102 Weather Forecasting Seminar**

Introduction to forecasting techniques including use of upper air observations and numerical forecast guidance. II(0,1)1

85.141 Weather & Climate

A general meteorology course for the non-science major. Topics include: atmospheric composition; solar radiation; temperature; moisture and condensation; relationship between air pressure and wind; weather patterns; severe weather; optical phenomena in the atmosphere; and the behavior and possible change of climate. I,II(3,0)3

85.301 Atmospheric Dynamics

The variables of state, Charles' law, Boyle's law, equation of state for an ideal gas, mixtures of gases. Thermodynamics of dry air, water vapor and moist air. Clausius-Clapeyron equation. Adiabatic and pseudoadiabatic processes. Moisture variables. Hydrostatics equilibrium, hydrostatics of special atmospheres. Hydrostatic stability. Convection theory, parcel method, slice method, entrainment, bubble theory. Prerequisite: 87.202.92.132, 95.103. II(3,0)3

85.304 Methods in Meteorology I

The application of vector analysis to dynamic meteorology. Three-dimensional divergence and vorticity, circulation, and solenoids. Selected ordinary and partial differential equations of fluid mechanics and their solutions. Spectral decomposition of hemispheric wave motion. Prerequisite: 87.202, 92.234 I(3,0)3

85.305 Methods in Meteorology II

Fundamentals of numerical weather prediction. Data analysis methods in meteorology using the techniques of curve fitting, correlation, and power spectrum analysis. Solution of stability problems. Prerequisites: 92.263 and 85.304 II(3,0)3

85.306 Environmental Problem Solving

The focus of the course is the development of problem-solving skills. Applications are made to a wide range of environmental problems that resemble real-world situation. The emphasis in the course, however, is on the thought process necessary to solve complex problems. Analysis of the problems consider from "hand-waving" to exact solutions, how and where to find the necessary governing equations and input, how and when to make approximations, and how to ensure that your answer is reasonable and, hopefully, correct. Prerequisite: 95.103. I(3,0)3

85.308 Forecasting and Synoptic Techniques I

Explores techniques of synoptic analysis including graphical subtraction, thickness analysis, isentropic analysis, streamlines and trajectories, divergence and vorticity. The use of a computer to perform these computations is explored through student projects. Prerequisite: 85.102, 87.202 I(1,4)3

85.309 Forecasting and Synoptic Techniques II

Explores three-dimensional structure and dynamics of mid-latitude storm systems; capabilities and limitations of the barotropic model; quasi-geostrophic model; and operational primitive equation models. Some mesoscale phenomena are covered as time permits including coastal cyclogenesis, thermal lows, and sea-breeze circulations. Prerequisite: 85.308 II(1,4)3

85.313 Physical Climatology

Atmospheric processes determining the climate; solar and terrestrial radiation, ele-

vation and thermal properties of surfaces, atmospheric circulations and eddy conduction between the atmosphere and land or sea surfaces, heat and water balance of earth's surface and the atmosphere; hydrologic cycle; and climatic simulation models. Prerequisite: 87.202 or permission of instructor I(3,0)3

85.340 Tropical Meteorology

An introduction to the tropical atmosphere including tropical climatology, structure and dynamics of easterly waves, tropical cyclones and monsoonal circulations. Prerequisite: 87.202 I(3,0)3

85.350 Satellite and Radar Meteorology

Explores theory and applications of radar, satellites, and lidar. Use of satellite imagery as a forecasting aide; theory and use of satellite profiling; and application of conventional and Doppler radar to severe weather and short term forecasting. Use of lidar and other profiling techniques to determine vertical temperature structure and turbulence. Prerequisite: 87.202 II(3,0)3

85.360 Upper Atmosphere Meteorology

Explores structure of the stratosphere, mesosphere, and thermosphere. Chemistry and photochemistry of the upper atmosphere; formation and maintenance of ozone layer; and UVB absorption. General circulation of the stratosphere; quasi-biennial oscillation; and sudden stratospheric warming. Ionospheric structure, magnetosphere, and aurora borealis. Prerequisite: 87.202 II(3,0)3

85.403 Physical Meteorology

Explores solar and terrestrial radiation processes and the heat balance of the atmosphere; fundamentals of radiation theory; radiative transfer processes in the atmosphere; atmospheric condensation processes; and nucleation theory and the growth of water drops and ice crystals by condensation, sublimation and accretion. Prerequisite: 85.301 I(3,0)3

85.410 Advanced Forecasting

Advanced analysis techniques and their use as forecasting tools are explored in both manual and computer formats. Techniques include moisture advection; moist isentropic trajectories; boundary layer destabilization; and other state-of-the-art techniques. Application of tech-

niques to small and mesoscale phenomena. Prerequisite: 87.202 II(1,4)3

85.415 Advanced Atmospheric Dynamics I

Explores dynamics of rotating fluids in a rotating reference frame. Conservation laws (momentum, continuity, and thermodynamics energy equations). Scale analysis, geostrophic balance. Applications to balanced flow, streamlines and trajectories, thermal wind, vertical motion, and surface pressure tendency. Circulation and vorticity, potential vorticity equation, barotropic and baroclinic vorticity. Prerequisite: 85.301, 92,234. I(3,0)3

85.416 Advanced Atmospheric Dynamics II

Atmospheric turbulence and boundary layer equations. Secondary circulation and spindown. Quasi-geostrophic prediction, diagnosis of vertical motion, and baroclinic disturbances. Atmospheric oscillations and perturbation theory. Hydrodynamic Instability, baroclinic instability, and baroclinic waves. Prerequisite: 85.415. II(3,0)3

85.483 Solar-Terrestrial Relations

This course presents an overview of solar-terrestrial relations with emphasis on morphology, related electromagnetic theories and a study of quiescent and disturbed states. Topics include solar physics, interplanetary medium, the geomagnetic field and magnetospheric physics. Each student will select one topic for independent study to assess observational techniques or relevant theories. Prerequisite: 85.415. II(3,0)3

85.491 Directed Study in Atmospheric Science

Students, through regular and frequent consultation with the instructor, undertake independent study of a particular area of meteorology. Prerequisite: permission of instructor I,II(Arr)1-3

85.495 Honor's Research in Atmospheric Science

An individual or team research project carried out by qualified students with the approval of, and supervision by, a faculty member. Prerequisite: consent of supervising faculty member I,II(Arr)3-6

85.496 Practicum Experience

A program of on-campus and/or off-campus

experiences developed by the student in consultation with a faculty member and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of six credits. The practicum may not be substituted for a non-elective course in the major. Prerequisite: permission of the Department Chair I,II(Arr)1-3

85.523 Air Pollution Control

This course describes air pollutants, their characterization, ambient concentrations, effects on human health and the ecology, and the environmental laws and regulations that set standards on emission rates and ambient concentrations. The basics of air pollutant dispersion and transport are also covered. The main focus of the course is on emission control technologies for particulate matter, carbon monoxide, sulfur oxides, nitrogen oxides, organic and inorganic toxic pollutants. The following technologies are discussed: cyclones, scrubbers, electrostatic precipitators, baghouses, adsorption, absorption and incineration. The automobile and its emission control are reviewed. Alternative methods are also discussed, such as fuel substitution, conservation and efficiency improvement. I(3,0)3

85.571 Air Pollution Phenomenology

The course centers on transport, dispersion and transformation of air pollutants in the atmosphere. Atmospheric structure and dynamics are reviewed. The atmospheric dispersion equation is developed for instantaneous and steady state releases of pollutants, including the Gaussian Plume Equation for point, line and area sources. The sources and transport of particulate matter are discussed, including haze and visibility impairment. Other topics are photo-oxidants (ozone), acid deposition, stratospheric ozone depletion and the greenhouse effect. II(3,0)3

Environmental Studies Courses (Prefix: 87)

87.101 Intro to Environmental Science

A survey of the field of environmental science, curriculum options, and career opportunities. Presentations by members of the department and guest speakers. Only for Environmental Science majors. I(1,0)1

87.102 Environmental Problems Seminar

A survey of environmental problems and issues. Topics include air, water, and noise pollution; solid and liquid waste disposal; and the social, political, and economic implications of these issues. Readings, discussions, guest speakers, and field trips. Only for Environmental Science majors. II(1,0)1

87.104 Foundations of Conservation and Environmental Concern

A study of the evolution of American environmental perception. Topics include a review of the changes in the philosophical framework defining human relationships to federal land and water policy, as well as the contributions of naturalists, scientists and laymen toward establishing a concern for environmental quality. I,II(3,0)3

87.111 Environmental Science

A survey course for non-science majors. Topics include ecosystems, population growth, production and distribution of food, pest control, agricultural resources, the water cycle, energy resources, air and water pollution, hazardous chemicals, recycling, economic and legal aspects of environmental issues, and the question of sustainability. I,II(2,2)3

87.115 Astronomy

An introduction to the study of astronomy including historical development, instruments, solar system dynamics, planetary evolution, stellar systems and stellar evolution. I,II(3,0)3

87.117 Astronomy Laboratory

Intended to develop a deeper understanding of astronomy through an exposure to the methods and materials used in astronomical analysis. Corequisite: 87.115 I,II(0,2)1

87.201 Principles of Earth & Environmental Systems I

An integrated study of the interactions between the lithosphere, hydrosphere, atmosphere, and biosphere. Emphasis will be placed on the physical and biological principles which underlie and control these interactions, pollution, geologic hazards, climate change, and social and political aspects which govern our relationship with the natural environment. Only for Environmental Science majors. Prerequisite or Corequisite: one semester college chemistry, one semester college

physics. I(3,2)4

87.202 Principles of Earth & Environmental Systems II

A continuation of Principles of Earth & Environmental Systems. Only for Environmental Science majors.

Prerequisite: 87.201. Prerequisite or Corequisite: two semesters college chemistry, two semesters college physics II(3,2)4

87. 326 Introduction to GIS for Sector Applications

This course will introduce the basic Geographic Information Systems tools and functions with applications tailored to a specific discipline. When this course is offered the orientation for that semester will appear in the descriptions as "Introduction to GIS for Sector Applications". I,II(3,0)3

87. 403 Introduction to GIS using IDRISI

This course introduces the methods of Geographic Information Systems using the IDRISI GIS software platform. IDRISI is a robust raster based GIS package particularly suited for applications where remote sensing images constitute the dominant data source. I,II(3,0)3

87. 406 Geographic Information Systems

This course will cover the elements of a Geographic Information System commonly found in basic and mid-level GIS applications. This will include file organization, data entry including digitizing and image registration, geocoding, Structured Query Language (SQL) applications, map algebra and statistical model functions, as well as general issues related to GIS implementation and GIS product presentation in organizational settings. II(3,0)3

87.491 Directed Study in Environmental Studies

The student, through regular and frequent consultation with the instructor, undertakes independent study of a particular area of environmental science. Prerequisite: permission of instructor I,II(Arr) 1-3

87.495 Honors Research in Environmental Studies

An independent scientific research project carried out by a qualified senior under the

supervision of a faculty member.

Prerequisite: consent of supervising faculty member I,II(Arr)3-6

87.496 Practicum Experience

A program of on-campus and/or off-campus experiences developed by the student in consultation with a faculty member from the Department and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of six credits. The practicum may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. I, II (Arr) 1-3

Geography Courses (Prefix: 88)**88.101 World and Regional Geography**

A survey of the significance, characteristics, and principal geographic problems of the world's major regions. I(3,0)3

88.102 Geography of the U. S. and Canada

A regional geography of North America with emphasis on the human and physical characteristics of different geographic regions and their interaction with each other. II(3,0)3

Geoscience Courses (Prefix: 89)**89. 101 General Geology**

A survey of earth structure and processes covering earth materials, crustal dynamics, landform development, and earth history and the evolution of life. Designed for the general student. I,II(3,0)3

89.103 General Geology Lab

An introduction to the identification of rocks and minerals and the interpretation of topographic and geologic maps. Field trips as appropriate. Corequisite: 89.101 I,II(0,2)1

89.111 Ocean Science

A study of the biology, chemistry, geology and physics of the oceans, oceanic pollution, coastal processes, and the role of the oceans in weather and climate. Designed for the general student. I,II(2,2)3

89.201 Principles of Geology

A continuation of Principles of Earth & Environmental Systems for students in the Geoscience Concentration. Emphasis will be on historical geology, fossils, development of the rock record, surficial process-

es, geologic hazards, and the interpretation of spatial data. Prerequisite: 87.202
Corequisite: 89.203. I(3,0)3

89.203 Principles of Geology Laboratory

Corequisite: 89.201 I(0,3)1

89.301 Mineralogy & Crystallography

This course will introduce the concepts of crystallography necessary to prepare the student to use the analytical equipment of Optical Mineralogy and X-ray Crystallography. It also contains topics on the physical and chemistry of minerals aimed at improving the student's ability to identify mineral samples. A significant portion of the course will be devoted to an introduction to optical methods using oil immersion and thin section techniques. I(3,0)3

89.303 Mineralogy & Crystallography Lab

corequisite: 89.301 I(0,2)1

89.304 Igneous & Metamorphic Petrology

The origin and evolution of igneous and metamorphic rocks. Emphasis will be on physical and chemical processes; magma transport and crystallization, phase equilibria, development of metamorphic facies, open and closed system behavior, and the development of metamorphic fabric. Prerequisite: 89.301 II(3,0)3

89.306 Igneous & Metamorphic Petrology Lab

Identification and classification of igneous and metamorphic rocks. Emphasis is on thin section identification and use of rock textures and compositions as guides to petrogenesis. Prerequisite: 89.303. Corequisite: 89.304 II(0,3)1

89.314 Hydrogeology

A study of the distribution and movement of water on the earth's surface with emphasis on the geologic effects. Topics include: application of statistics to streams, ground-water flow nets, and well hydraulics. Prerequisite: 92.131 II(3,0)3

89.315 Environmental Geochemistry

Application of geochemical principles to environmental problems including air pollution and atmospheric processes, climate change, water chemistry and water-rock interactions, and the transport and dispersal of organic and inorganic pollutants. Prerequisite: 87.202 or permission of

instructor I(4,0)4

89.316 Geomorphology

A study of the physical and chemical processes at work on the earth's surface which result in the formation and development of surface features. Emphasis is placed on the mechanics of erosion (water, wind, ice, and waves) and the morphology and spatial distribution of the resultant landforms. Prerequisite: 89.201. Corequisite: 89.318 II(3,0)3

89.318 Geomorphology Lab

Corequisite: 89.316 II(0,2)1

89.322 Structural Geology

An analysis of crustal deformation through detailed study of geologic structures with emphasis upon the response of geologic materials to stress and strain. Field techniques, tectonic principles, and geometrical analysis are employed. Prerequisite: one semester of physics. Corequisite: 89.324 I(3,0)3

89.324 Structural Geology Lab

Corequisite: 89.322 I(0,2)1

89.326 Glacial & Pleistocene Geology

A survey and interpretation of the erosional and depositional effects of glaciation with emphasis on the New England area. Topics include glaciology, glacial geology, and Pleistocene stratigraphy. Prerequisite: 89.316 I,II(3,0)3

89.352 Sedimentation & Stratigraphy

Principles and processes of sedimentation: erosion, mechanics of transport, diagenesis and lithification, models for sedimentary environments. Development of the stratigraphic record, relative and absolute time, and seismic stratigraphy. Prerequisite: 89.201. Corequisite: 89.354. II(3,0)3

89.354 Sedimentation & Stratigraphy Lab

Determination of mass properties of sediments with emphasis on mechanical and statistical analysis, identification and description of sedimentary rocks, facies models and stratigraphic cross-sections. Corequisite: 89.352 II(0,2)1

89.452 Advanced Geochemistry

Application of chemical principles to geological and environmental problems. Topics include abundance and distribution of elements in the earth, crystal chemistry, stable and radiogenic isotopes, radiogenic

dating, isotopic and elemental tracers, water-rock interactions. Prerequisite: one year of college chemistry I,II(3,0)3

89.456 Applied Geophysics

Application of geophysics to problems in geology and environmental science. Principles and techniques of gravity, magnetic, electrical, and seismic methods. Field projects and surveys. Prerequisite: one year of college physics I,II(2,2)3

89.491 Directed Study In Geoscience

The student, through regular and frequent consultation with the instructor, undertakes independent study of a particular area of the geosciences. Prerequisite: permission of instructor I,II(Arr)1-3

89.495 Honors Research in Geoscience

An independent scientific research project carried out by a qualified senior under the supervision of a faculty member. Prerequisite: consent of supervising faculty member I,II(Arr)3-6

89.524 Regional Hydrogeology

Concentrating on the storage and steady state flow of ground water at a basin-wide scale, the course studies flow nets, fluid potential, and numerical modeling of flow controlled by basin geometry and geology; water movement in the zone of aeration, the interaction of ground-water with surface water, the transport and dispersion of contaminants, and the use of modeling for ground-water management. Prerequisite: permission of the instructor I,II(3,0)3

Department of Economics

Ernesto F. Sanz, Chairperson

Professors: Carol McDonough, Ernesto Sanz, Balbir Sihag

Associate Professors: Michael Carter, George Dery, Supriya Lahiri, Paul E. Snoonian

Assistant Professor: Monica Galizzi

Affiliated Faculty: Jean Pyle

Department Location: Falmouth Hall, Room 302

Telephone: (978) 934-2780

Economics Major

Economics as a discipline is concerned with the principles underlying the production and exchange of products and services. The study of economics stems from the scarcity of resources and the limitless nature of our demands for products and services. Societies must therefore choose the goods and services that will be produced from among the larger range of production possibilities. Economics develops the principles and concepts that follow from this fact of scarcity and applies them to the analysis of various aspects of human activity.

The Economics major may choose one of three "tracks" of study, or select an array of six upper level courses of his/her own choice. The selected tracks are the following:

General Economics Track

International Economics Track

Environmental Economics & Urban Economics Track

All Economics majors must take the following courses:

- 49.201 Economics I
- 49.202 Economics II
- 49.211 Statistics for Business & Economics I
- 49.212 Statistics for Business & Economics II
- 49.303 Microeconomic Theory
- 49.304 Macroeconomic Theory

Introductory courses in the Economics Department (49.201 and 49.202), which may be taken in either order, survey economic problems, policies, and theory. Required courses in microeconomic and macroeconomic theory and in statistics provide a deeper analytical foundation and the necessary quantitative tools. In addition to these required courses, the student chooses economics electives as specified by the track he/she has chosen. Those electives provide students with opportunities to explore subject areas that are of personal interest and consistent with career objectives.

Besides these six courses, a major in Economics must choose one of two options: proficiency in a modern language, or proficiency in quantitative skills. Students who choose the International Economics Track must take the modern language option (Consult the "University Academic Policies: Language Requirement" section for details).

The option in quantitative skills requires the fulfillment of the following:

1. at least two courses from the following Mathematics Department offerings

- 92.121 Pre-Calculus Math
- 92.122 Differential Calculus
- 92.201 Integral Calculus

2. at least two of the following quantitative economics courses:

- 49.211 Statistics I
- 49.212 Statistics II
- 49.312 Managerial Economics
- 49.407 Econometrics.

General Economics Track

This track is designed to provide the student with a strong and flexible background in economic theory and some important applications of that theory. In addition to the six required courses, the student chooses six additional economics courses, of which at least two must be at the 400 level. The mathematics requirement for this track is Pre-Calculus Math (92.121) and Calculus (92.122).

International Economics Track.

This track is designed to acquaint students with international economic theory

and policy issues, as well as expertise in the language and culture of a particular area of the world. Three major areas of specialization are offered: East Asia, Latin America, and Europe. The student selects one of these areas and chooses courses in languages, history, political science, etc., related to this area. In addition, it is strongly recommended that the student spend a semester abroad in the area he or she chooses.

This track consists of eleven economics courses, as well as several courses from other departments, as described below. In economics, in addition to the six required courses, students take:

- 49.403 International Trade Theory and
- 49.307 Government & Business; plus two international economics electives from the following:
- 49.320 Comparative Economics Systems
- 49.310 Economics of Less Developed Countries
- 49.322 Japan in the Global Economy; and one free economics elective.

The mathematics requirement for this track is Pre-Calculus Math (92.121). Students are also required to take World and Regional Geography (88.101), Introduction to International Relations (46.121), and one course each in the History and Political Science of the area they choose.

Environmental Economics & Urban Economics Track

This track is designed to acquaint the student with the applications of economic theory to important public policy issues concerning the effect of economic activity on the environment, energy use, and the quality of life in urban areas. It consists of twelve economics courses, as well as two courses in the sciences, as described below. In economics, in addition to the six required courses and two free economics electives, the student chooses four courses from the following:

- 49.305 Women, Minorities & Immigrants in the Labor Force
- 49.306 Urban Economics
- 49.315 Introduction to Environmental

	Economics
49.319	Public Finance
49.328	The Economics of Energy and the Environment
49.329	The Economics of Ecological Preservation

*Consult the Academic Policy section of this catalogue for the General Education requirements in the sciences.

Minor in Economics

Eighteen (18) credits hours are needed for a minor in Economics. All minors must take Economics I (49.201) and Economics II (49.202). Four additional economics electives are required, two of which must be at the 300 level or 400 level.

Within this general framework, a wide variety of options is open to students who minor in economics. Courses can be taken to emphasize a particular area like international, quantitative or environmental economics, or a series of courses can be chosen from different areas to strengthen or complement the student's major discipline. Some of these courses are required in many MBA programs and some schools waive them if they have been taken at the undergraduate level.

The following are some of the courses from which a minor can choose grouped by general areas:

General Economics:

49.302	Labor Economics	
49.303	Microeconomic Theory	15
49.304	Macroeconomic Theory	
49.305	Women, Minorities and Immigrants	
49.306	Urban Economics	
49.318	Financial Markets and Monetary Policy	
49.319	Public Finance	
49.325	U.S. Economic History	15
	Environmental Economics:	
49.315	Introduction to Environmental Economics	
49.328	The Economics of Energy and the Environment	

49.329	The Economics of Ecological Preservation	
	International Economics:	
49.310	Economics of Less Developed Nations	
49.320	Comparative Economic Systems	15
49.322	Japan in the Global Economy	
49.323	The Economics of East Asia	
49.335	International Political Economy	
49.403	International Trade Theory	

Quantitative Economics:

49.211	Statistics for Business and Economics I	
49.212	Statistics for Business and Economics II	15
49.312	Managerial Economics	
49.407	Econometrics	

Sample Courses of Study for Economics

For students entering in Fall 1999 and subsequently

Track I : General Economics

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
49.201	Economics I	3
92.121	Precalculus	3
	Beginning Language I	3
	Beh & Soc Studies (Gen Ed)	3

Spring Semester

42.102	College Writing II (Gen Ed)	3
49.202	Economics II	3
92.122	Differential Calculus	3
	Beginning Language II	3
	Science* (Gen Ed)	3

Sophomore Year

Fall Semester

49.211	Statistics I	3
92.201	Integral Calculus	3

Intermediate Language I	3
Science* (Gen Ed)	3
Beh & Soc Studies (Gen Ed)	3

Spring Semester

49.212	Statistics II	3
	Historical Studies (Gen Ed)	3
	Intermediate Language II	3
	Literature (Gen Ed)	3
	Free Elective	3

Junior Year

Fall Semester

49.301	Microeconomic Theory	3
49.	Economics Elective	3
49.	Economics Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3

Spring Semester

49.302	Macroeconomic Theory	3
49.	Economics Elective	3
49.	Economics Elective	3
	Values, C & C	3
	Free Elective	3

Senior Year

Fall Semester

49.4	Economics Elective	3
	Science* (Gen Ed)	3
	Free Elective	3
	Free Elective	3
	Free Elective	3

Spring Semester

49.4	Economics Elective	3
	Free Elective	3

Free Elective	3
Free Elective	3
Free Elective	3

15

Junior Year**Fall Semester**

49.211	Statistics I	3
49.403	International Trade	3
	Science* (Gen Ed)	3
	Free Elective	3
	Free Elective	3

15

Spring Semester

49.212	Statistics II	3
49.	Int'l Economics Elective	3
	Values, C & C (Gen Ed)	3
	Literature (Gen Ed)	3
	Free Elective	3

15

Senior Year**Fall Semester**

49.	Economics Elective	3
49.	Int'l Economics Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
	Free Elective	3

15

Spring Semester

49.307	Government & Business	3
41.366	International Law	3
	Free Elective	3
	Free Elective	3
	Free Elective	3

15

*Consult the Academic Policies section of this catalogue for the General Education requirements in the sciences.

Track III : Environmental & Urban Economics**Freshman Year****Fall Semester**

42.101	College Writing I (Gen Ed)	3
49.201	Economics I	3

92.121	Precalculus	3
	Beginning Language I	3
	Beh & Soc Studies (Gen Ed)	3

15

Spring Semester

42.102	College Writing II (Gen Ed)	3
49.202	Economics II	3
92.122	Differential Calculus	3
	Beginning Language II	3
	Science* (Gen Ed)	3

15

Sophomore Year**Fall Semester**

49.211	Statistics I	3
92.201	Integral Calculus	3
	Intermediate Language I	3
	Science* (Gen Ed)	3
	Free Elective	3

15

Spring Semester

49.212	Statistics II	3
	Beh & Soc Studies (Gen Ed)	3
	Intermediate Language II	3
	Values, C & C (Gen Ed)	3
	Free Elective	3

15

Junior Year**Fall Semester**

49.301	Microeconomic Theory	3
49.	Economics Elective	3
49.	Economics Elective	3
	Historical Studies (Gen Ed)	3
	Free Elective	3

15

Spring Semester

49.302	Macroeconomic Theory	3
49.	Economics Elective	3

Track II: International Economics**Freshman Year****Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.121	Precalculus	3
49.201	Economics I	3
	Beginning Language I	3
	Beh & Soc Studies (Gen Ed)	3

15

Spring Semester

42.102	College Writing II (Gen Ed)	3
49.202	Economics II	3
	Beginning Language II	3
	Science* (Gen Ed)	3
	Free Elective	3

15

Sophomore Year**Fall Semester**

49.301	Microeconomic Theory	3
88.101	World & Reg Geog (Beh & SS)	3
	Historical Studies (Gen Ed)	3
	Intermediate Language I	3
	Free Elective	3

15

Spring Semester

49.302	Macroeconomic Theory	3
46.121	Intro to Int'l Relations	3
	Science* (Gen Ed)	3
	Intermediate Language II	3
	Free Elective	3

15

49. Economics Elective 3
 Aesthetics (Gen Ed) 3
 Free Elective 3
 15

Senior Year**Fall Semester**

49. Economics Elective 3
 Literature (Gen Ed) 3
 Science* (Gen Ed) 3
 Free Elective 3
 Free Elective 3
 15

Spring Semester

49. Economics Elective 3
 Free Elective 3
 Free Elective 3
 Free Elective 3
 Free Elective 3
 15

- 84.101 Applied Chemistry for the Non-scientist

- 93.141 Weather & Climate

*Consult the Academic Policies section of this catalogue for the General Education requirements in the sciences.

**Economics Courses
(Prefix: 49)**

49.101 The Economics of Social Issues
 The course addresses the economic base of social issues and introduces students to the principles regulating the mix of goods produced; the methods of production chosen; and the distribution of incomes generated within profit driven, market-based economic systems. 3 cr

49.201 Economics I

A study of the principles of production and exchange. An introduction to demand, supply, pricing, and output under alternative market structures. Derived demand and resource markets are introduced. 3 cr

49.202 Economics II

A study of the principles governing the level of national income and employment. Examination of the commercial banking system, monetary and fiscal policy, the international economy, and alternative economic systems. Prerequisite: 49.201 3 cr

49.211 Statistics for Business and Economics I

Descriptive statistics, sophisticated counting techniques and other components of probability, simple random variables and their distribution, bivariate functions, sampling theory properties of estimators. Prerequisite: 92.122 or equivalent 3 cr

49.212 Statistics for Business and Economics II

Interval estimation, hypothesis testing, analysis of variance, applied regression theory, correlation analysis, and other selected topics. Prerequisite: 49.211 3 cr

49.301 Computer Applications of Microeconomics

The course develops skills in the use of the internet, spreadsheets and word processors in order to analyze problems in applied microeconomics. Market analysis of individual companies and industry studies provide the analytical framework of the course. Prerequisite 49.201 3 cr

49.302 Labor Economics

The effect of American capitalism on the position of labor. The rise of union organization and the factors in its growth. Trends in the labor force, money and real wages, wage problems and wage differentials, problems of hours and working conditions, and causes and remedies for unemployment. Prerequisites: 49.201 and 49.202 3 cr

49.303 Microeconomic Theory

An advanced examination of price and production theory and the theory of the consumer and the firm. Prerequisites: 49.201, 49.202 3 cr

49.304 Macroeconomic Theory

An analysis of Keynesian and post-Keynesian theory. National income accounts, monetary and fiscal policy, and econometric models. Prerequisites: 49.201, 49.202 3 cr

49.305 Women, Minorities and Immigrants in the Labor Force: Theoretical and Policy Issues

Use of economic theory to explain the

subordinate roles these groups have had in the U.S. labor force. Given their importance for future growth, we examine ways to incorporate them more fully including controversial public policy issues such as affirmative action, immigration reform, childcare, parental leave and comparable worth. Prerequisite: 49.201 or 49.202 3 cr

49.306 Urban Economics

An introduction to urban economics. Analysis of intrametropolitan spatial relationships including location, land use, and housing markets. Prerequisite: 49.201 or 49.202 3 cr

49.307 Government & Business

An examination of various governmental and nongovernmental controls on business and nonprofit organizations. Emphasis is on the impact of laws, court interpretations, economic theories, social and political philosophies, and ethical consideration on these organizations. Students have an opportunity to examine business decisions which involve questions of value and choice. Prerequisites: 49.201, 49.202 3 cr

49.308 Case Studies in Government Regulation

Provides students with cases involving application of economic analysis including pollution regulation and industry-specific regulation. Students are expected to write reports on topics assigned for research in this course. Prerequisite: 49.307 3 cr

49.310 Economics of Less Developed Countries

Formulation of an approach to development that includes the role of goals (growth, equity), sectors (agriculture, industry, services), resources (labor, capital, technology), government, international (trade, investment, debt), and political and socio-cultural factors. Examines 'success' in a few Asian countries, failure in most of Africa, and crisis in South America emphasizing current controversies. Prerequisite: 49.201 or 49.202 3 cr

49.312 Managerial Economics

Economic theory and statistical methods applied to business decision making. Estimation of demand, production, cost functions and accompanying elasticity estimates, pricing and output decisions, value maximization problems, and capital budgeting. Prerequisites: 49.201, 49.202,

49.211, 49.212 3 cr

49.315 Introduction to Environmental Economics

Environmental problems caused by externalities and market failure are examined. An analysis of pollution controls such as voluntary programs, direct controls, taxes on emissions, and other monetary incentives are evaluated. Environmental problems in planned economies are also discussed. Prerequisite: 49.201 3 cr

49.316 Business & Economic Forecasting

Develops the fundamentals of forecasting for managerial decision making. Topics covered are data collection, review of basic statistical concepts, and computerized forecasting techniques. The forecasting models developed include averaging, smoothing, time series, correlation, and regression. Prerequisites: 49.201, 49.202, 49.211, 49.212 3 cr

49.317 Capital Markets

A study of the principles of portfolio theory and the pricing of financial instrument in capital markets. Use of derivative markets to implement arbitrage, hedging and risk management strategies. Extensive background institutional detail on stock, bond, mortgage-backed, currency, futures and options market. 3 cr

49.318 Financial Markets and Monetary Policy

The economics of financial intermediation and central bank monetary policy. Evaluation of global financial markets, financial deregulation, bank failures and financial stability, determinants of the level and term structure of interest rates, and the impacts of monetary policy changes on overall levels of output, employment and prices are topics analyzed in this course. Prerequisites: 49.201, 49.202 3 cr

49.319 Public Finance

The economics of the public sector. Principles of public expenditure, taxation, and the public debt applied to federal state, and local governments. Prerequisites: 49.201 or 49.202 3 cr

49.320 Comparative Economic Systems

Analysis of free-market and planned economies in theory and practice. Emphasis on the United States, Japan, EC

countries and the former Soviet Block nations. Prerequisite: 49.201 or 49.202 3 cr

49.322 Japan in the Global Economy

A review of the postwar Japanese Economy and its legacy from the Tokugawa, Meiji and Taisho periods. An analysis of economic and management policies to explain postwar Japan's high rate of economic growth. A review of fiscal, monetary and industrial policies; labor, management, and government structures; and external economic relations. Prerequisite: 49.202 3 cr

49.323 The Economies of East Asia

The study of the high performing Asian economies. Economic growth is related to public policy, macroeconomic stability, equity and its institutional framework, export promotion models, human capital formation, savings and investment policies, use of market mechanism in allocating resources. 3 cr

49.325 U.S. Economic History

The evolution of institutions and their functions, and sources of economic development. The contributions of railroads, agricultural population growth, immigration, capital formation and technological progress to economic development. Other areas addressed: rapid industrialization and antitrust laws; evolution of financial institutions, the creation of the Federal Reserve System, crash of 1929, the depression of the 1930s, the New Deal and various banking acts; the labor movement; the growth of international trade. Prerequisite: 49.201 or 49.202 3 cr

49.326 History of Economic Thought

The rise of classical growth and value theories. The evolution of neoclassical theories of price and distribution, and the development of welfare criteria. A comparison of Keynesian and classical macroeconomic theory. The role of economic analysis of the post-Keynesian world. Prerequisites: 49.303 and 49.304 or permission of instructor 3 cr

49.328 The Economics of Energy and the Environment

Economic and policy issues related to the use of energy and the environment. Topics include: Energy demand analysis; Inter factor and inter fuel substitution; Supply uncertainty problems; Energy pricing; Energy/Environment/Macro-economic

linkages; intertemporal allocations; trade-off issues between growth and stable and cleaner environment; Pollution potential of major energy resources; Greenhouse effect; Economics of pollution control and energy policy; Energy conservation and efficiency; Scarcity and the limits to growth. Prerequisite: 49.201 3 cr

49.329 The Economics of Ecological Preservation

Survey of static and dynamic social welfare theory as applied to environmental preservation issues. Complications introduced by non-reproducible goods, irreversible processes, and incompletely specified property rights. Limitations of unregulated market price signals in achieving either efficient or sustainable intertemporal resource allocations. Role of government in creating efficient market structures. Detailed applications to the problem areas of forestry management, maintenance of biological diversity, waste disposal, global warming. Prerequisite: 49.201. Recommended: 49.315 3 cr

49.335 International Political Economy

Explores current international issues (flows of trade, money, and debt; multinational corporations and workers; regional integration; environmental concerns) within the context of historical trends and different theoretical approaches 3 cr

49.337 Technological Change and Economic Growth

The study of economic growth through improvements in the usage of capital, labor, energy, and other resources. An examination of classical capital accumulation models including Karl Marx, Neoclassical Growth, and Schumpeter's theory of unstable growth. Discussion of technological diffusion, innovation, and invention. Prerequisites: 49.201 or 49.202, 49.212 3 cr

49.345 Economics of the Health Industry

A review of the major developments in the health care industry during the last forty years. The anatomy and workings of health care industry: the hospitals, the physicians, the insurance companies, the HMOs, the pharmaceutical companies, the consumers and the Government. The problems of moral hazard and adverse selection. Government regulation of health

care industry and Government-provided health care programs. International comparisons of health care systems. Critically examining the various proposals to reform the health care industry: the cost, the quality and the universality of health care. Prerequisite: 49.202 3 cr

49.403 International Trade Theory

The classical and modern theories. International payments, exchange and trade controls, and international trade policy determinants. Prerequisites: 49.201, 49.202. 3 cr

49.407 Econometrics

Review of the basic assumptions, estimation with deficient data, multiple regression, formulation and estimations of special models, the generalized linear regression model and its applications, and simultaneous equation system. Prerequisites: 49.201, 49.202, 49.211, 49.212 or permission of instructor 3 cr

49.436 Financial Economics

Topics include risk aversion and stochastic dominance, the mathematics of portfolio frontiers, capital asset pricing, pricing of options, equilibrium valuation and arbitrage valuation of multiperiod securities. Econometric issues in capital asset pricing. Prerequisites: 49.201, 49.202, 49.212 or permission of chairperson 3 cr

49.496 Internship in Economics

The course is restricted to majors in Economics. The objective of the practicum is to obtain experience in the application of economic knowledge and analysis. By working in preapproved environments students can enhance the applied knowledge of economic principles underlying the operation of public and private institutions. The practicum cannot replace the required courses of the major but three credits may be applied to the fulfillment of a 400 level economics elective. Another three credits can be earned in a subsequent semester as an additional economics elective. The grading of the course is "satisfactory" or "unsatisfactory." Prerequisite: permission and supervision of the chairperson or his/her designee is needed.

49.499 Directed Studies

A course to permit the advanced student to do research in topics of special interest in economics under faculty supervision. This course also may be utilized to offer

topics to individual students where there are insufficient number of registrants for a regular class. Restricted to Economics majors. Prerequisite: permission of the chairperson. 3 cr

49.615 Environmental and Natural Resource Economics

The development of concepts and methods of economic analysis with a view toward their application for preserving the environment. An analysis of economic growth and the usage of depletable resources. Appraisal of quantitative methods for measuring environmental damage and the cost of abatement. Prerequisite: graduate student or permission of chairperson. 3 cr

Department of English

William H. Roberts, Chairperson

Professors: William C. Burto (Emeritus), Robert J. Foy (Emeritus), Arthur Friedman (Emeritus), William Hersey, Mary Kramer, Clifford Lewis, Martha McGowan, Barbara Miliaras, Gerard W. O'Connor (Emeritus), Judith Pastore (Emerita), William Roberts, Robert Stein, Robert Wiehe (Emeritus), Joseph Zaitchik, Charles E. Ziavras (Emeritus)

Associate Professors: Donald Berry (Emeritus), Andrea Corbett, William Coughlin, Hilary Holladay, John McCaffrey, Melissa Pennell, Charles Ryan

Assistant Professor: Diana Archibald, Arthur Dabilis, Tara Elyssa, Jeannie Judge, Marlowe Miller, Nancy Selleck, Anthony Szczesiul

Department Location: O'Leary Library, Room 412

Telephone: (978) 934-4182

The English Department offers a major in English leading to the Bachelor of Arts Degree. The Department offers a general minor in English and specialized minors in English literature, American literature, drama, writing, journalism/communications, and theater arts.

The English Major

(30-45 credits)

The English Department offers two concentrations: one in literature and the other in writing. Both concentrations require an intermediate proficiency in a foreign language.

The Literature Concentration requires the following nine courses:

- 42.201 Great Books of Antiquity
- 42.291 History of English Literature I
- 42.292 History of English Literature II
- 42.293 History of English Literature III
- 42.294 History of American Literature I
- 42.295 History of American Literature II
- 42.296 History of American Literature III

42.307 History and Development of English Language, or

42.308 Analysis of Modern English

42.423 Shakespeare I, or

42.424 Shakespeare II

In addition, literature concentrators must take an additional nine credits at the 300 or 400 level. The Department recommends 300 and 400 level courses from the following periods:

Medieval and Renaissance

Restoration and Neoclassical

Romantic and Victorian/Nineteenth Century

Twentieth Century

Literature concentrators are also limited to six departmental credits of 200 level courses beyond those required.

The Writing Concentration

The Writing Concentration requires:

42.201 Great Books of Antiquity

Two courses selected from the following three surveys:

42.291 History of English Literature I

42.292 History of English Literature II

42.293 History of English Literature III

Two courses from the following three surveys:

42.294 History of American Literature I

42.295 History of American Literature II

42.296 History of American Literature III

And:

42.307 History and Development of the English Language, or

42.308 Analysis of Modern English

42.423 Shakespeare I, or

42.424 Shakespeare II

In addition, Writing Concentrators must take:

42.227 Essay Writing for English Majors

42.496 Practicum in Writing (Students must arrange for their practicum experience during the pre-regis-

tration period with Professor Coughlin.)

and choose three courses from the following list:

42.300 Intro to Journalism

42.301 Newswriting

42.302 Creative Writing: Fiction

42.303 Creative Writing: Poetry

42.305 Reviewing the Arts

42.306 Professional Writing

42.309 Argumentation & Research Skills

42.320 Personal & Reflective Writing

42.323 Writing About People

42.386 The Science of Editing

42.387 The Art of Publishing

42.390 Technical and Scientific Writing

42.391 Business Communication

42.402 Topics in Writing

Requirements for Minors

Every English Department minor is open to students enrolled in any undergraduate college at the University. The minor requires 18-24 credits, six of which must be at the 300 level or above.

American Literature

A minor in American Literature consists of 18-24 credits selected in accordance with the following specifications; at least six credits must be taken at the 300 level or above:

42.294 History of American Literature I

42.295 History of American Literature II

42.296 History of American Literature III

42.291 History of English Literature I or

42.292 History of English Literature II or

42.293 History of English III

Electives in American Literature

Dramatic Literature

A minor in Dramatic Literature consists of 18-24 credits selected in accordance with the following specifications; at least six credits must be taken at the 300 level or above:

42.218 Comedy

42.219 Tragedy

42.423 Shakespeare I

42.424 Shakespeare II

Electives in Dramatic Literature

English (General English Minor)

This minor consists of 18-24 credits of coursework selected in accordance with the following specifications including six credits at the 300 level or above:

42.291 History of English Literature I

42.292 History of English Literature II

42.293 History of English Literature III

42.423 Shakespeare I or

42.424 Shakespeare II

One course in American Literature English elective

English Literature

This minor consists of 18-24 credits of coursework, including the following required courses; at least six credits must be taken at the 300 level or above:

42.291 History of English Literature I

42.292 History of English Literature II

42.293 History of English Literature III

42.423 Shakespeare I or

42.424 Shakespeare II

Electives in English Literature

Journalism

Students in the journalism minor must take the following sequence of courses plus two additional writing courses from English Department offerings, for a minimum of 18 credits:

1. 42.227 Essay Writing for English Majors

2. 42.300 Intro to Journalism

3. 42.301 Newswriting

4. Special Topics: Feature Writing or
Special Topics: Freelance Writing

Theater Arts

The interdisciplinary minor in Theater Arts is designed to offer students professional instruction to and supervision in the practical work of Theater together with critical study of the history and forms of dramatic literature. The minor consists of 18-24 credits of coursework (6 credits of

which must be taken at the 300 level or above) in the following four categories:

1. Theater arts workshops: at least 6 credits. Students are encouraged to take 42.384 Working with the Playscript at the beginning of their course work.*
2. Dramatic literature and music: at least 6 credits. At least 3 credits must be in pre-modern drama.*
3. Practicum in Theater: 3 credits. To be arranged during pre-registration period.
4. Production experience and portfolio credit. (See Program Coordinator for details).

*Lists of appropriate courses are available from the Program Coordinator, Professor Selleck. English majors who wish to complete a minor in Theater Arts should consult the Program Coordinator.

For a complete listing of Theater Arts courses, please refer to the section of this publication entitled "Interdisciplinary and Intercollegiate Minors."

Writing

The writing minor consists of 18-24 credits of coursework selected in accordance with the following specifications:

1. To be eligible, students must complete 42.227, Essay Writing for English Majors and 42.308 Analysis of Modern English.

2. In addition, students must complete at least two writing courses from the following list; one of these courses must be a Writing Workshop:

- | | |
|--------|---|
| 42.300 | Journalism I |
| 42.301 | Journalism II |
| 42.302 | Creative Writing: Fiction |
| 42.303 | Creative Writing: Poetry |
| 42.305 | Reviewing the Arts |
| 42.306 | Professional Writing |
| 42.309 | Argumentation & Research Skills |
| 42.320 | Personal & Reflective Writing |
| 42.323 | Writing About People |
| 42.386 | The Science of Editing |
| 42.387 | The Art of Publishing |
| 42.390 | Advanced Technical & Scientific Writing |

- | | |
|--------|--|
| 42.391 | Business Communication |
| 42.402 | Topics in Writing |
| 42.450 | Writing Workshop |
| 3. | The remaining courses (6 to 12 credits) may be selected from the English Department's general offerings. |

Literature Concentration:

Suggested program for a course of study.

Freshman Year

Fall Semester

- | | | |
|--------|----------------------------|----|
| 42.101 | College Writing I (Gen Ed) | 3 |
| 92. | Math* (Gen Ed) | 3 |
| | Beginning Language I | 3 |
| | Beh & Soc St (Gen Ed) | 3 |
| | Free or Minor Elective | 3 |
| | | 15 |

Spring Semester

- | | | |
|--------|-----------------------------|----|
| 42.102 | College Writing II (Gen Ed) | 3 |
| | Science* (Gen Ed) | 3 |
| | Beginning Language II | 3 |
| | Historical Studies (Gen Ed) | 3 |
| 42.201 | Great Books of Antiquity or | |
| | Free or Minor Elective | 3 |
| | | 15 |

Sophomore Year

Fall Semester

- | | | |
|--------|-----------------------------|----|
| 42.294 | History of Eng Lit I | 3 |
| 42.291 | History of American Lit I | 3 |
| 42.201 | Great Books of Antiquity or | |
| | Free or Minor Elective | 3 |
| | Science* (Gen Ed) | 3 |
| | Intermediate Language I | 3 |
| | | 15 |

Spring Semester

- | | | |
|--------|--------------------------|----|
| 42.292 | History of Eng Lit II | 3 |
| 42.295 | History of Am Lit II | 3 |
| | Concentration Elective | 3 |
| | Beh & Soc St (Gen Ed) | 3 |
| | Intermediate Language II | 3 |
| | | 15 |

Junior Year

Fall Semester

- | | | |
|--------|----------------------------|----|
| 42.307 | Hist/Dev of Eng Lang or | |
| 42.308 | Analysis of Modern English | 3 |
| 42.293 | English Lit III | 3 |
| 42.3 | Concentration Elective | 3 |
| | Science* (Gen Ed) | 3 |
| | Free or Minor Elective | 3 |
| | | 15 |

Spring Semester

- | | | |
|--------|------------------------|----|
| 42.296 | American Lit III | 3 |
| 42.3 | Concentration Elective | 3 |
| | Values, C & C (Gen Ed) | 3 |
| | Free or Minor Elective | 3 |
| | Free or Minor Elective | 3 |
| | | 15 |

Senior Year

Fall Semester

- | | | |
|--------|------------------------|----|
| 42.423 | Shakespeare I or | |
| 42.424 | Shakespeare II | 3 |
| 42.4 | Concentration Elective | 3 |
| | Aesthetics (Gen Ed) | 3 |
| | Free or Minor Elective | 3 |
| | Free or Minor Elective | 3 |
| | | 15 |

Spring Semester

- | | | |
|------|-------------------------|----|
| 42.4 | Concen or Free Elective | 3 |
| 42.4 | Concen or Free Elective | 3 |
| | Free or Minor Elective | 3 |
| | Free or Minor Elective | 3 |
| | Free Elective | 3 |
| | | 15 |

You are required to take 15 credits at the 300 or 400 level. These credits include required courses like Shakespeare. Similarly, not counting required courses, such as English and American Literature, you cannot take more than two courses at the 200 level.

* Consult the Academic Policies section of this catalogue for the General Education requirements in math and sciences.

Writing Concentration:

Suggested programs for a course of study:

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Math* (Gen Ed)	3
	Beginning Language I	3
	Beh & Soc St (Gen Ed)	3
	Minor Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
	Beginning Language II	3
	Historical Studies (Gen Ed)	3
42.201	Great Books of Antiquity or	
	Minor Elective	3
		15

Sophomore Year**Fall Semester**

42.294	History of Eng Lit I or II	3
42.291	History of Amer Lit I or II	3
42.201	Great Books of Antiquity or	
	Minor Elective	3
42.227	Essay Writing - English Majors or	
	Science* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

42.292	History of Eng Lit II or III	3
42.295	History of Amer Lit II or III	3
42.227	Essay Writing - English Majors or	
	Science* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year**Fall Semester**

42.307	Hist/Dev of Eng Lang or	
42.308	Analysis of Modern English	3

42.3	Concentration Elective	3
42.3	Concentration Elective	3
	Science* (Gen Ed)	3
	Minor Elective	3
		15

Spring Semester

42.3	Concentration Elective	3
42.3	Concentration Elective	3
	Values, C & C (Gen Ed)	3
	Minor or Free Elective	3
	Minor Elective	3
		15

Senior Year**Fall Semester**

42.423	Shakespeare I or	
42.424	Shakespeare II	3
	Concentration Elective	3
	Aesthetics (Gen Ed)	3
	Minor Elective	3
	Minor Elective	3
		15

Spring Semester

42.4	Concen or Free Elective	3
42.4	Concen or Free Elective	3
42.496	Practicum - Required	3
	Free or Minor Elective	3
	Free or Minor Elective	3
		15

* Consult the Academic Policies section of this catalogue for the General Education requirements in math and sciences.

**English Courses
(Prefix 42)**

42.100 College Writing A—International (Sections 101, 102)
Review of basic rules of grammar with special attention to the difficulties of the ESL student. 3cr

42.100 College Writing A

Provides an intensive review of the basic rules of grammar and the basic principles of rhetoric necessary for success in College Writing I. Prerequisite: permission. 3cr

42.101 College Writing I

Examines the writing process and reviews fundamentals of grammar, sentence structure, and paragraph development. Students analyze rhetoric models by professional writers and are introduced to library research and techniques of documentation. Seven expository essays are required. 3cr

42.102 College Writing II

Reinforces the principles of good writing established in College Writing I. Students submit six essays based on critical analysis of readings in fiction, drama, and poetry. One documented research paper is required. Prerequisite: 42.101. 3cr

**42.103 College Writing I for
International Students**

For students who speak English as a second language. Equivalent to 42.101. Credit for both 101 and 103 not granted. 3cr

**42.104 College Writing II for
International Students**

For students who speak English as a second language. Equivalent to 42.102. Credit for both 102 and 104 not granted. 3cr

Note: Students must complete requirements for College Writing I and College Writing II before registering for upper level English courses. Exception: English majors may register for 42.102 and 42.201 concurrently.

42.201 Great Books of Antiquity

A study of representative selections from the Bible, Homer, and the classical age of Greece and Rome. Works will be considered in their historical and cultural contexts. 3cr

**42.202 Great Books of the Modern
Period**

A study of representative literary selections from the period of the Enlightenment to the present. 3cr

**42.205 Human Values in Western
Culture I**

Address some of the important questions of human existence through a close study of representative literature from ancient times to the present. In the first semester students explore and evaluate three perennial themes: the problem of evil; self and society; freedom and fate. 3cr

**42.206 Human Values in Western
Culture II**

A continuation of 42.205. In the second

semester students explore and evaluate three perennial themes: the pursuit of knowledge; the nature of human kind; the experience of love. May be taken independently of 42.205. 3cr

42.210 Drama

A study of plays from the classical period to the present. 3cr

42.211 Poetry

A study of poems from the Renaissance period to the present. 3cr

42.212 The Short Story

A study of the modern short story, with representative works from the nineteenth century to the present. 3cr

42.216 The Short Novel

A study of nineteenth and twentieth century short novels as a literary genre. 3cr

42.217 The Horror Story

A study of the genre. Focus on major writers from Poe to the present. 3cr

42.218 Comedy

A study of the theory and the practice of comedy from Greek writers to the present. 3cr

42.219 Tragedy

A study of the theory and practice of tragedy from Greek writers to the present. 3cr

42.220 Communications for Software Development

Students develop communications skills for professional environments. Course includes preparation and delivery of presentations and practice in various forms of business writing as it relates to the computer industry. Limited to Computer Science majors. 3cr

42.222 Oral Communication

Communication skills for a variety of personal and professional contexts, including delivery and criticism of extemporaneous speeches, interview techniques, and presentations. 3cr

42.223 Essay Writing for International Students

Analysis of various essay writing techniques and styles with ample opportunity for student writing. Advanced practice with areas of difficulty for ESL students. 3cr

42.224 Business Writing

Theory and practice of letters, memoran-

da, and reports on specific business and technical problems. Restricted to students enrolled in the College of Management. 3cr

42.225 Basic Technical Writing

An introduction to basic techniques and formats used for communicating technical and scientific information in the work place. Intended for engineering and science majors. Other majors must have instructor's permission. No COM majors. 3cr

42.226 Technical and Communication

Theory and practice of letters, memoranda, reports, and oral presentation on specific scientific and technical problems. 3cr

42.227 Essay Writing for English Majors

Class time is divided between analyzing and discussing the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis is places on the writing process from prewriting through drafting and revising. English majors and minors only. 3cr.

42.228 Word Processing Laboratory

Training in word processing skills to help writers improve ideation, composition, and revision. The lab explores commands such as indexing, find and replace, and inserting footnotes and tables. 1cr

42.229 Essay Writing for Non-English Majors

Class time is divided between analyzing and discussing the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis is on the writing process from prewriting through drafting and revising. Non-English majors only. 3cr

42.230 Film Classics

A study of the elements of film as revealed in selected film classics. Emphasis on critical analysis and evaluation. 3cr

42.232 Turning Fiction into Film

A study of literary works and their films adaptations. Emphasis on analyzing what is at stake when the textual is adapted to a visual context. 3cr

42.234 Futuristic Fiction

A study of English, American, and European novels which offer visions of the future based upon present political, social, and scientific trends. 3cr

42.235 Writers of the Merrimack Valley

A survey of historical and contemporary regional authors. Students will read a series of books and write essays in response to reading assignments. 3cr

42.240 Literature and Women

A survey of literary attitudes toward women from the Judaic and Hellenic periods through the present. 3cr

42.241 Women in Film

A survey of the image of women in commercial film from the beginnings to the present. Focus on films of the 1930's-40's and 1970's -80's. 3cr

42.243 Contemporary Women Writers

A study of recent work in the novel, short story, drama, and poetry by British and American women. 3cr

42.244 Women in the Middle Ages and Renaissance

A study of major literary and historical women of the Middle Ages and Renaissance. Attention to impact on their times and their place in society. 3cr

42.248 Values in American Culture

Deals with the development and interrelationship of American views on individualism, nature, science, technology, democracy, ethnicity, and the American dream. Readings begin with the Puritans and end with contemporary essayists. 3cr

42.250 The Bible as Literature

A reading of the Bible as literature, not forgetting that it is a library with its own requirements and aims. We also place the Bible in history considering the redactors, the formation of the canon, and translations. 3cr

42.253 The Culture of American Sport

An examination of the history, literature, sociology, and aesthetics of sport. Attention to corollary issues and values including racism, sexism, and violence. 3cr

42.257 The Family in American Literature

A study of literary selections dealing with traditions of family life, the individual, and social change. 3cr

42.259 Protest Fiction in America

A study of American fiction concerned with the oppression of blacks, working people, working people, and the poor. 3cr

42.261 Acting

Theory and practice of acting including exercises in the elements and methods of acting and the preparation of a public performance. 3cr

42.262 Advanced Acting

A continuation of 42.261 which is a prerequisite. 3cr

42.264 Directing Workshop

Introduction of the process of directing plays of different styles. Students will direct scenes with other members of the workshop and their work will be analyzed by the instructor and fellow students. 3cr

42.267 Introduction to Shakespeare

A study of selected histories, comedies, and tragedies. Not for English majors. 3cr

42.272 Continental Fiction

A study of selected fiction by major continental writers of the nineteenth and twentieth centuries. 3cr

42.274 Literature of the Beat Movement

A study of the Beat rebellion in the context of the 50's and 60's in America. Writers include Burroughs, Corso, Ferlinghetti, Ginsburg, Kerouac. 3cr

42.276 Irish American Literature

A study of fiction, drama, poetry, and popular culture of the American Irish from immigration to the present. 3cr

42.277 Cross-Cultural Perspectives in American Literature

The course addresses the literature of America's immigrant and cultural groups and how it contributes to defining our national character. 3cr

42.282 Crime in Literature

A study of how various authors use crime as a plotting device to study character, reveal social order, and criticize social instructions. 3cr

42.291 History of English Literature I

A survey of representative writers and works from the Anglo-Saxon period to the mid-seventeenth century. 3cr

42.292 History of English Literature II

A survey of representative writers and works from Milton into the Romantic period. 3cr

42.293 History of English Literature III

A study of the historical development of English Literature from the Romantic period to the present. 3cr

42.294 History of American Literature I

A study of the historical development of American literature from the colonial period to the Civil War. 3cr

42.295 History of American Literature II

A study of the historical development of American literature from the Civil War to World War I. 3cr

42.296 History of American Literature III

A study of the historical development of American literature from World War I to the present. 3cr

42.300 Intro to Journalism

An introduction to techniques of writing for the news media. 3cr

42.301 Newswriting

Introduction to techniques of radio and television newswriting, to fundamentals of public affairs reporting, and to principles of newspaper editing. 3cr

42.302 Creative Writing: Fiction

Theory and practice of fiction. Conducted as a workshop with close analysis of student work. 3cr

42.303 Creative Writing: Poetry

Theory and practice of poetry. Conducted as a workshop with close analysis of student work. 3cr

42.304 Creative Writing: Playwriting

Theory and practice of playwriting. Conducted as a workshop with close analysis of student work. 3cr

42.305 Reviewing the Arts

Theory and practice of writing short, critical essays in a journalistic mode on the visual and performing arts. Special attention to theater, movie, and television criticism. Conducted as a workshop with close analysis of student work. 3cr

42.306 Professional Writing

The procedures and process used when writing professionally from the query letter to the final draft. Intermittent drafts will be submitted for comment, with special attention to editorial preferences and

deadlines. The course will focus on writing for magazines. 3cr

42.307 History and Development of the English Language

A study of the phonetic, lexical, syntactical, and semantic shifts in the English language from its beginnings to the present. 3cr

42.308 Analysis of Modern English

A study of English syntax examining traditional, structural, and transformational grammars. Attention to issues of dialect, usage, phonology, and morphology. 3cr

42.309 Argumentation and Research Skills

Analyzing and writing arguments. Emphasis on the claim, support, and warrant approach to argumentation. Attention to research skills and bibliographic techniques applying both to traditional and the developing electronic resources. 3cr

42.311 The South in American Literature

A study of the writers, movements, and social culture of the South, from both the nineteenth- and twentieth-centuries. 3cr

42.312 American Puritanism as Literary Influence

A study of Puritan values in selected colonial writings and in confrontation with other values in nineteenth-century literature. 3cr

42.313 Realism and Naturalism in American Fiction

A study of realism and naturalism in fiction from the end of the Civil War to World War I. 3cr

42.314 Labor and the Working Class in American Fiction

A study of American novels and short stories that address the issues and conditions of labor and the working class. Issues to be addressed include reform, empowerment, assimilation and access to resources. 3cr

42.317 British Literature of the Twentieth Century

A study of twentieth-century British short stories, poetry, and drama. 3cr

42.318 American Literature of the Twentieth Century

A study of twentieth-century American novels, short story, poetry, and drama. 3cr

42.319 The American West: Myth and Reality

A study of the American West expressed in the cultural imagination of Americans. Readings and documentaries about the arts, exploration, water resources, urban life, ethnic cultures, and feminist influences offer contrasting perspectives to the western myth. 3cr

42.320 Personal and Reflective Writing

A workshop format encourages peer criticism of individual writings and discussion of models from various texts. 3cr

42.323 Writing About People

Primarily writing essays, but other forms such as interviews and stories may also be used. Topics include family members as well as people you have less experience of; you also read and write about other authors writing about people in a variety of forms. Meetings emphasis participation in workshops. 3cr

42.324 Writing About Nature and the Environment

A study of literature that depicts the natural world. Reading and writing about such authors as Dillard, Abbey, Erlich, Leopold, and Silko. Consideration of environmental concerns expressed by these writers. 3cr

42.325 The Rise of the Novel

A study of the British novel in the eighteenth century from DeFoe through Austen. 3cr

42.326 Nineteenth Century British Novel

A study of the novel from Scott through Hardy. 3cr

42.330 Twentieth Century British Novel

A study of the novel from Conrad through Greene and others. 3cr

42.331 American Novels to 1900

A study of the American novel from colonial beginnings to 1900. 3cr

42.332 Twentieth Century American Novel

A study of the American novel from 1900 to the present. 3cr

42.335 American Women Novelists

A study of selected novels by American women. Focus on the female voice within the American tradition. Treatment of such issues as domesticity, education, and authorship. 3cr

42.345 Female English Novelists

Selected novels by writers such as Austen, the Brontes, Eliot, Woolf, Bowen, and Drabble. 3cr

42.347 Modern Irish Drama

A study of the evolution of the Irish stage to the present - from Yeats to Friel. 3cr

42.348 Modern American Drama

A study of such playwrights as O'Neill, Odets, Wilder, Williams, and Miller. 3cr

42.351 Literature of the Middle Ages

A study of the prose, poetry, and drama of England from 1200-1500 set against cultural and historical backgrounds. 3cr

42.352 Literature of the Sixteenth Century

A study of English prose and poetry of the period. 3cr

42.353 Literature of the Seventeenth Century

A study of English prose and poetry of the period excluding Milton. 3cr

42.354 Literature of the Eighteenth Century

A study of the prose and poetry of the period. 3cr

42.355 Literature of the Romantic Period

A study of English prose and poetry from 1798-1832. 3cr

42.356 Literature of the Victorian Period

A study of British Fiction, poetry, and prose from 1830 to 1900. 3cr

42.358 The Shaping of the American Theater

A study of the 18th, 19th, and 20th century playwrights and trends that shaped the modern American theater. Focus on key writers influencing trends. 3cr

42.359 Contemporary World Drama

A study of important recent works by playwrights from around the globe. 3cr

42.360 Medieval & Renaissance Theater

A study of Medieval mystery cycles, morality plays, interludes, and other forms of popular and court theater. 3cr

42.361 Restoration Comedy

A study of comic plays from 1660 to the mid-eighteenth century. Focus on the works of Ethridge, Wycherley, Congreve, and Sheridan. 3cr

42.362 Modern Drama

A study of selected Continental, British, and American plays from the late nineteenth century to the present. 3cr

42.363 Elizabethan & Jacobean Drama

A study of major dramatists of the Age of Shakespeare including Marlowe, Dekker, Webster, Jonson, Beaumont and Fletcher, Massinger, Ford and others. 3cr

42.365 Creative Writing: Fiction II

Advanced workshop in writing fiction. Offered in conjunction with the Division of Continuing Education Summer Program. 3cr

42.366 Creative Writing: Poetry II

Advanced workshop in writing poetry. Offered in conjunction with the Division of Continuing Education Summer Program. 3cr

42.367 Creative Writing: Playwriting II

Advanced workshop in writing plays. Offered in Conjunction with the Division of Continuing Education Summer Program. 3cr

42.370 Contemporary American Fiction

A study of novels and short fiction from World War II to the present. 3cr

42.371 Contemporary British Fiction

A study of novels and short fiction from World War II to the present. 3cr

42.372 Contemporary World Literature

A comparative study of literature works in English from India, Africa, Australia, the Caribbean, and other areas of multicultural tradition. 3cr

42.373 Modern Poetry

A study of the development of British and American poetry from 1900 through World War II. 3cr

42.374 Contemporary Poetry

A study of selected British and American Poets since World War II. 3cr

42.375 Modern Irish Literature

Poetry, drama, and prose fiction from the Irish literary renaissance to the present. Writers will include Yeats, Joyce, O'Casey, Friel and Heaney. 3cr

42.376 African-American Fiction

A study of selected works by black American writers, such as Toomer, Wright, Ellison, Walker, and Morrison. 3cr

42.379 Aging, Illness, and Death

A comparative study of attitudes toward aging, illness, and death as portrayed in selected literary works examined in their historical and cultural contexts. 3cr

42.380 War in Literature

A study of conflict and human values in times of war. Focus on fiction and poetry treating World War I, World War II, and Vietnam. 3cr

42.381 The Existential Hero

A study of the evolution of the existential hero in European and American literature and film. 3cr

42.384 Working with the Playscript

A hands-on introduction to the dramatic text as script intended for production. Conducted as a seminar/workshop with attention to both the critical interpretation and staging of various dramatic forms. 3cr

42.386 The Science of Editing

The course will examine the varied editing roles in a publishing company, from acquisitions to copy editing. 3cr

42.387 The Art of Publishing

The course will examine the nature of publishing from traditional modes to desktop production, including the development of the industry and the reasons for change. The course also includes hands-on publishing activities, such as designing newsletters. 3cr

42.388 Undergraduate Seminar on the Teaching of Writing

Training in writing theory for direct application in peer tutoring. Discussion supplemented by experimental exercises, class presentations, reading, and writing. Meets two hours each week. Students tutor four hours each week. 3cr

42.389 Undergraduate Seminar in High School Teaching

Class meets weekly to examine secondary school curricula and methodology. Regularly schedules participation in English classes in local secondary schools is a major requirement. 3cr

42.390 Technical and Scientific Writing

A study of and practice with techniques and formats used for communicating technical and scientific information. Primarily for students considering career in or associated with technical writing. Intended for

English majors and minors. Other majors must have instructor's permission. No COM majors. 3cr

42.391 Business Communications

A study of special problems of writing in business including strategies for correspondence, presentation of complex information, and writing for sales. For English majors and minors. 3cr

Note: Courses numbered 400 and above are restricted to English majors and minors.

42.401 Selected Authors

A study of selected works. Authors to be announced each semester. 3cr

42.402 Topics in Writing

A study of issues and the practice of skills needed in specific areas of professional writing. Topics to be announced each semester. 3cr

42.403 Special Topics: Feature Writing

Discussion and practice of skills necessary for newspaper feature writing. Special attention to lead writing, the "nut" paragraph, attribution, transitions, dialogue, and the inverted pyramid. Field experience. Guest writers and editors. Preparation of submissions for public encouraged. Prerequisite 42.300 3cr

42.404 Special Topics: Freelance Journalism

Discussion and practice of the strategies and skills necessary to writing and publishing as a freelance journalist from query letters to "stringing" and developing a niche. Prerequisite: 42.300. 3cr

42.411 Desktop-Publishing Laboratory

Adjunct to 42.387. Advanced word processing and computer-assisted proofing and page layout. Desktop technology related to printing, including font manipulation and graphic design. 1cr

42.415 Young Adult Literature-Critical Methods

Using young adult literature as a vehicle, this course considers traditional methods of interpretation and evaluation. Particular attention is given to the analytical, psychological and sociological approaches. 3cr

42.241 Chaucer

A study of the major works of Chaucer in Middle English. 3cr

42.423 Shakespeare I

A study of selected histories, comedies, and tragedies. 3cr

42.424 Shakespeare II

A study of selected histories, comedies, and tragedies not covered in 42.243. Readings in Shakespeare I and II to be announced each semester. 3cr

42.426 Milton

A study of the major poems and selected prose. 3cr

42.429 Introduction to Literary Theory

A solid introduction to major trends in contemporary critical theory. Emphasis on producing a sample critical paper treating one or more current critical approaches to reading a literary text. 3cr

42.430 Literary Criticism

A study of major statements about literature from Aristotle and Plato through contemporary critics. 3cr

42.431 Contemporary Linguistic Theory

Examines how and why children acquire the complex rules of grammar (linguistic competence) as well as the rules of the appropriate social use of language (communicative competence). The focus of the class is on the linguistic systems which enable us to describe the stages of language development. 3cr

42.450 Writing Workshop

A substantial writing project is developed through collaborative efforts of a student's major department and the Department of English. Permission of Chairperson required. 3cr

42.491 Directed Study in Literature

The student develops a plan of directed reading, defines a problem for individual research, and prepares a paper or papers. 3cr

42.492 Directed Study in Language Analysis

The student develops a plan of directed readings in linguistics, semantics, or stylistics and defines a topic for individual research. 3cr

42.493 Directed Study in Creative Writing

The student develops a series of projects in creative writing and composes poetry, fiction, or drama. 3cr

42.494 Directed Study in Theater

The Student develops a project or series of projects in theater arts and/or stagecraft. 3cr

42.495 Practicum in Theater

A part-time full-semester internship at an approved off-campus theater. To be arranged through the Program Coordinator during pre-registration period. 3cr.

42.496 Practicum

An off-campus writing experience for English Majors. Practicum experience is intended to provide students with the opportunity of applying their writing skills in actual business, technical, or professional situations. 3cr

Department of History

Charles F. Carroll, Chairperson

Professors: Christos Bantas, Mary Blewett, Peter Blewett, Charles Carroll, Liana Cheney, Jonathan Liebowitz, Joseph Lipchitz, Donald Mattheisen

Associate Professors: Richard Derry (Emeritus), George Luter, John Shea

Assistant Professor: Caryn Bell, Shehong Chen, Michael Pierson, Alice Walters

Affiliated Faculty: Dean Bergeron, Laurence Gross

Department Location: Coburn Hall, Room 114

Telephone: (978) 934-4120

History Major

The Department of History provides students with a broad introduction to civilizations of the past and present including those of antiquity, Europe, America, and the Third World. Through a broad exposure to the complexities shaping the forces of civilization, the history major develops a thorough grounding in the historical process, a greater empathy, and a special perspective for viewing human thought and action. The student of history is aware of the distinctiveness of past individuals and societies but also recognizes the continuities connecting the experiences of different people over time.

Sensitive to the realities of continuity and change, the student of history develops the ability to determine bias, to make valid generalizations, to draw valid inferences, and to perceive the significance of fact within the framework of interpretations. A major in History provides a meaningful background for students who desire to enter government service, politics, law, teaching, or business.

The major in History consists of 36-45 credits (with at least 15 credits at the 300 course level or above) and must include the following:

- 43.105 Western Civilization to 1715
- 43.106 The Modern World
- 43.298 Intro to Historical Method
- 43.432 Research Seminar in History*

*not an absolute requirement, but recommended for students planning advanced study

The Department also requires two courses on or above the 200 level in both European and American History, two additional courses in either European or American History, and one of the following courses dealing with the Third World: 43.272, 273, 290, 293, 295, 318, 321, 387, 393. The Third World requirement also may be fulfilled with 46.368, Middle East Politics, which carries history credit. A maximum of six credits in United States history survey courses may be counted as part of the first 36 credits for the history major. The remaining courses for the major may be selected from any of the history courses at the 200-level and above.

Students transferring to the College who wish to major in history must make individual arrangements with the Chairperson of the Department regarding satisfaction of major requirements.

The Department offers two additional specialized concentrations within the major, which are designed to take advantage of the strengths of the faculty and the immediate locality. They are: 1) the American Industrial Revolution and 2) Modern European Social and Economic History. Students interested in these concentrations should contact the Chairperson for more information.

Minor Requirements*American History*

A minor in American History consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

European History

A minor in European history consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

General History Minor

A minor in history consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

Interdisciplinary Minors

Students should refer to the listing of interdisciplinary minors in the social sciences and humanities, which is at the end of the College of Arts and Sciences section of this catalogue.

General Requirements

The history major consists of 36-45 credits and at least 15 credits at the 300/400 level.

Course of Study

For students entering in Fall 1993 and subsequently:

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
43.105	Western Civilization to 1715	3
	Beginning Language I	3
92.	Mathematics* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
43.106	The Modern World	3
	Beginning Language II	3
	Science I* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
		15

Sophomore Year**Fall Semester**

43.	U.S. History Elective	3
43.	European History Elective	3
	Literature (Gen Ed)	3
	Science II* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

43	European History Elective	3
43.298	Historical Methods	3
	Aesthetics (Gen Ed)	3
	Science III (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year**Fall Semester**

43.	Third World History Elective	3
43.	History Elective	3
	Values, C & Choice (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

43.	U.S. History Elective	3
43.	History Elective	3
	History Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year**Fall Semester**

43.	History Elective**	3
	History or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

	History or Free Elective	3
	History or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policies section of this catalogue for the General Education requirements in mathematics and the sciences.

**43.432 Research Seminar may be required for entry into some graduate programs. The Department recommends this course for all students who plan to apply for graduate programs in History.

Art History Concentration

Note: See course and program descriptions listed under Art History.

The Bachelor of Art in History with an Art History concentration is a baccalaureate degree program offered in the Department of History in the College of Arts and Sciences.

The art history concentration is designed to develop and foster historical, aesthetic and multicultural appreciation of art as well as analytical, critical, and theoretical knowledge of art. An art history concentration provides also for students an understanding of a cultural and artistic diversity in the arts. Art history courses are taken under the auspices of the History Department in the College of Arts and Sciences.

An art history concentration in the Bachelor of Arts in History consists of 36 to 45 credits distributed with the following requirements. All courses are selected in consultation with the Art History Coordinator.

1. Two Foundations Art History courses (6 credits).
Survey of Art I (58.203) and Survey of Art II (58.204). All art history students must take Survey of Art I and II prior to entering the upper-level art history courses
2. Two Foundations History courses (6 credits)
Western Civilization to 1715 (43.105) and The Modern World (43.106)
3. Art History Electives (9 credits or three courses minimum, from this selection 6 credits or two courses must be at the 300 level and above, or maximum 18 credits or 6 courses, from this selection 12 credits or four courses must be at the 300 level and above)
4. History Electives (9 credits or three courses, at least 6 credits or two courses at the 300 level, related to the art historical period of the student's course of study)
5. Practicum Experience or Directed Studies in Art History or History (6 credits)
6. Reading knowledge of foreign language related to art historical interest or concentration is strongly encouraged

History Courses (Prefix: 43)**43.101 Classical Civilization**

Political, social and cultural history of the Graeco-Roman world from the age of heroes to the fall of the Roman Empire. (Not open to History concentrators.) 3 cr

43.105 Western Civilization to 1715

Traces the major forces in the development of European history from the beginning of Greek civilization to 1715. 3 cr

43.106 The Modern World

Examines the major forces in the development of modern European history in a global context from the origins of the French Revolution to the present. 3 cr

43.111 United States History to 1877

Traces the development of American History and institutions from Colonization to the end of Reconstruction. 3 cr

43.112 U.S. History Since 1877

Examines significant developments in American History from the end of the Reconstruction Period to the present. 3 cr

43.204 China and the Modern World

This course introduces China's interactions with the world since the 1840s. With the Opium War as the starting point, students are ushered into a traditional China whose political system, cultural values, and an economic structure stood in sharp contrast to those of the outside world. The main focus of the course is then to explore the process in which China fought for its survival as a sovereign nation and searched for its road to modernization. Important questions asked in the course are what internal and external forces stimulated or hindered China's development; and why China reacted to certain events and forces the way it did. 3 cr

43.206 American Economic History

A study of the growth and development of the American economy from its European origins to the present. 3 cr

43.210 History of American Popular Culture

An investigation of the social content and institutional character of mass culture in America since 1850. 3 cr

43.216 American Urban History I

An examination of the process of urbanization in America. Topics covered include the origin and development of the American city, ethnic conflict, the political machine, police and transportation. 3 cr

43.217 American Urban History II

A continuation of 43.216. Topics include poverty, housing, health delivery, suburbanization, and city planning. 3 cr

43.225 Ancient Greek History and Civilization

A study of Greek history, institutions and culture from Minoan times through the Hellenistic period. 3 cr

43.226 Roman History and Civilization

An analysis of the history, institutions and culture of the Roman Empire from the earliest times to 330 A.D. 3 cr

43.227 The Middle Ages

A survey of the Latin West during the formative period from the Roman Empire to the creation and development of the first European civilization. 3 cr

43.231 Renaissance and Reformation

The history of Europe in the time of transition between the late Middle Ages and the Early Modern Period. Two principle topics are the intensification of cultural change which began in Italy around 1300 and spread slowly northward and the disruption of the unity of the Western Christian Church. 3 cr

43.237 Europe in the Twentieth Century

An examination of selected topics in European history from 1914 to the present: World War I, the Versailles conference, unrest and collapse of collective security, the rise of Communism, Fascism, Nazism, World War II and post war developments. 3 cr

43.240 World War I: Causes and Consequences

A general survey of the war together with a closer examination of selected topics. 3 cr

43.255 The History of Germany to 1871

Political and cultural development of the German nation from the Reformation to the creation of a unified nation-state in the nineteenth century. Topics include the Renaissance and the Reformation, the Thirty Years War, the rise of Brandenburg-Prussia, German absolutism in the era of Frederick the Great, the German Enlightenment, the upheaval of the French Revolutionary era, and the growth of German nationalism. 3 cr

43.258 The History of Russia to 1796

The growth of the Russian state: Varangian origins, the Kievan state, conversion to Christianity, Mongol domination, the rise of Muscovy, Europeanization and expansion under Peter the Great and Catherine the Great. 3 cr

43.261 Greek and Roman Historians

Extensive reading in English translation of important Greek and Roman historians. Works of Herodotus, Thucydides, Xenophon, Livy, Tacitus, and Procopius. 3 cr

43.270 Women in American History

A study of women as a social group in American History. 3 cr

43.272 The American Indian

A study of the American Indian before the introduction of white European civilization. The course examines the history and culture of selected tribes of several regions within the present boundaries of the United States. 3 cr

43.273 American Indians and the U. S.

A study of the conquest and domination of American Indians from the formation of the United States government to the present. The course focuses on the evolution and implementation of Indian policy and the forces which influenced U. S. relations with Indian tribes. 3 cr

43.290 The Orient Since 1500

This survey concentrates on China, Japan, and India as the three dominant contemporary civilizations. The course begins with an analysis of them as traditional societies and then traces their history in response to the impact of aggressive modernizing states of Western Europe and America. 3 cr

43.291 Conquest of the Americas

A study of the conquest and domination of the native peoples of the Western hemisphere by the imperialist powers of Europe and the succeeding governments of the Americas. The course focuses on the development and implementation of policies of the dominant governments, from discovery to the present. 3 cr

43.295 History of Japan Since 1600

A study of the traditional Japanese institutions and the transformation of Japan into a modern state after 1868: the Tokugawa Shogunate, Meiji Restoration, Russo-Japanese War, world power status, mili-

tarism, World War II, and present day Japan. 3 cr

43.296 United States Diplomatic History

Although the course takes the entire United States diplomatic history as its field of historical study, its focus is on the American foreign policy in the twentieth century. The course first explores domestic and international factors that made the United States a world power by 1898. It will then consider the goals, the practices, and the results of the twentieth century American foreign policy. The course challenges students to view American diplomacy in a global context. 3 cr

43.298 Introduction to Historical Methods

An introduction for the undergraduate student to the nature and principles of history. The course takes up methodology, historiography, research methods, electronic resources, bibliography, and the technical and stylistic problems involved in the presentation of research in scholarly form. Required of all history majors in the sophomore year. Non-majors are admitted with permission of the instructor. 3 cr

43.302 Byzantine History and Civilization

A study of the important political, social, and cultural changes in the East Roman Empire from the founding of Constantinople to the fall of the Empire in 1453 with emphasis on the role of Byzantium as the custodian of the classical past. 3 cr

43.304 European Social and Economic History Since the Industrial Revolution

The causes of the industrial revolution and the process of industrialization. Life in the urban, industrial world. New ideologies, new types of social organization, and European economic integration. 3 cr

43.308 History of Crime, Conflict, and Control in the United States

An analysis of the causes and development of attempts to control crime, ethnic conflict, radical protest movements, urban disorders, and attitude and role conflicts. 3 cr

43.310 History of New England

Explores the evolution of New England society from pre-Columbian to the Post-Industrial, emphasizing the ways succeed-

ing generations of New Englanders have confronted social and economic change. Topics include: white-Indian relations, ecological change, Puritanism, the New England town, the industrial revolution, the rise of cities, immigration, ethnic and class conflict, and the distinctiveness of the region. 3 cr

43.311 History of Science I: The Invention of Science

Explores the rise of the modern understanding of nature and the natural world as it developed in Western Europe, beginning with the establishment of universities and their elaboration of Aristotelian ideas and methods and the various institutional and cultural contexts in which they developed through the Renaissance, Scientific Revolution, and Enlightenment. 3 cr

43.312 Science and the Modern World

Examines the role of science in European and American society through the nineteenth and twentieth centuries. The course explores the development of new scientific theories in the life sciences and the physical sciences (including evolution, relativity, quantum mechanics, and genetics), addresses the institutionalization of science in Western society, and considers how science came to be applied to various social, cultural, and military concerns of the modern world. 3 cr

43.313 American Social History to 1880

Selected topics in American social history, including mobility and class structure, religion, ideals of family life and child rearing, race and ethnic groups, and myths and reality in economic life. 3 cr

43.314 American Social History Since 1880

A continuation of the preceding. Prerequisite: 43.313 or permission of the instructor. 3 cr

43.315 U.S. Women in Fiction

Literature often has been used by historians as source material for the lives of the American people. An examination of literature written by American women about the lives of various groups of American women yields insights into their position in nineteenth and twentieth-century American society. The explosion in women's studies has produced many reprints of published works available for this course, which will be a reading and

discussion seminar. Prerequisites: 43.270 Women in American History, an equivalent gender studies course, or permission of the instructor. 3 cr

43.318 Precolumbian America

A study of the native inhabitants of the Western Hemisphere from arrival to discovery by Europeans. The course focuses on the history and development of the social, economic and political institutions and the intellectual and artistic achievements of the major civilizations, in particular the Maya, Aztec, and Inca. 3 cr

43.322 Chinese Foreign Policy

Chinese foreign policy since 1949 with a strong emphasis on tracing the links between historical, ideological, and cultural influences, on the one hand, and pragmatic and nationalistic considerations on the other. While tracing these links, the course explores the intricate process of policymaking in the People's Republic of China. 3 cr

43.325 Christianity and Rome

Analyzes the late stages of the civilization of antiquity. The center of interest is the interaction of the new world-religion of Christianity with the mature Roman Empire: a cultural and political conflict which irrevocably changed the world. 3 cr

43.327 England in the Middle Ages

The history of the English people and nation from the Roman conquest to the end of the fourteenth century with special emphasis on the development of political and social institutions. 3 cr

43.330 Tudor England

An intensive study of the social, economic, and constitutional structure of England in the 16th century. The course begins with a review of the problems of the period 1399-1485. 3 cr

43.331 Stuart and Augustan England

A sequel to 43.330 (which is not a prerequisite). This course deals with the great revolution of the 17th century and its aftermath and concludes with the emerging political stability to 1760. 3 cr

43.334 The French Revolution and Napoleon

A close analysis of French society from 1600-1815 which attempts to understand the cause of the French Revolution and its aftermath. 3 cr

43.336 Problems of Modern Ireland
Study and discussion of problems of 20th century Ireland set in their historical perspective. 3 cr

43.340 Topics in the History of Science

This course focuses on specialized topics in the history of science. Such topics might include several of the following: the role of women in western science, gender and science, the relationship between scientific and occult beliefs, the nature of scientific revolutions, and the sociology of science in different historical contexts. There are no prerequisites, but students should have had some history courses; 43.311 or 43.312 are recommended. 3 cr

43.350 Colonial America: History and Culture

Emphasis is on the British North American and Caribbean colonies of the 17th and early 18th centuries. Topics include: the impact of European pandemic diseases on the native American populations; new European technologies and the transformation of the environment; contrasts between religious, social, and economic developments in New England and those in the settlements to the south; a comparative analysis of slavery; and the beginnings of modernism. 3 cr

43.352 The Coming of the American Revolution

A study of 18th-century British America with emphasis on the paradoxes of unity and diversity, Anglophilia and Anglophobia, slavery and freedom, and enlightenment rationalism and evangelical religion. The course also deals with the major causes, events, and interpretations relating to the coming of the American Revolution. 3 cr

43.353 The American Revolution and the Beginnings of Constitutional Government

A study of the War for Independence, the creation of republican forms of government, and the formation of the Federal Constitution. 3 cr

43.354 The American Revolution and Social Change

An examination of the far-reaching social, political, and economic consequences of the revolt of the thirteen colonies against British rule. 3 cr

43.356 Civil War and Reconstruction
Examines the Civil War and Reconstruction, not only in terms of events but also in the light of traditional and revisionist interpretations. 3 cr

43.358 Amazing American Lives
Biography often has been used by historians as source material for representing the nature of the American experience. An examination of outstanding biographies of the lives of various Americans can yield insights into all levels and ranks of American society from colonial days to the late twentieth century. 3 cr

43.360 The Gilded Age: United States History, 1877-1900

An examination of the social, cultural, and political changes involved in the development of the United States as a modern industrial nation and its rise to status as a world power. 3 cr

43.362 The 20's and the 30's

An examination of the emergence of the corporate and governmental institutions of modern America set in two turbulent decades of cultural and political ferment that involved both booming prosperity and the economic collapse of the Great Depression. 3 cr

43.363 Recent U. S. History: 1940 to the Present

The involvement of the U.S. in World War II marked a major turning point in American history. It ushered in decades of Cold War tensions, the militarization of society, participation in foreign alliances, and limited wars. Anti-communist conservatives, militant Blacks, and a New Left polarized politics produced a contemporary crisis of confidence in American society. 3 cr

43.364 War and Cold War: United States History in the 1940's and 1950's

An in-depth examination of the economic, political, social, and cultural consequences of World War II and the development of the Cold War. 3 cr

43.365 United States History Since 1960

A survey of Cold War politics and civil rights upheavals during the 1960s and 1970s, the decline of American economic and political power, and the resurgence of conservative politics in the 1980s. 3 cr

43.366 History of Germany Since 1871
Examines the meteoric rise and fall of modern Germany as a world power in its various manifestations as the German Empire, the Weimar Republic, and the Nazi state. Some attention is also given to the unification of East and West Germany and to the continued influence of the "German Question" in world affairs. 3 cr

43.367 France Since 1814

A History of France in a broad European setting from the Bourbon restoration through the Fifth Republic. The course intensely examines the interaction of social, economic, political, and diplomatic trends, with particular attention to the struggle between the Right and the Left. 3 cr

43.369 Russia in the 19th and 20th Centuries

Selected topics in modern Russian history: political and social reforms of the nineteenth century, international policies in Europe and Asia, the 1917 revolutions, development of the new regime under Lenin, Stalinist policies, World War II and Russian expansion. A comparative study of these topics underscores patterns of continuity in both Tsarist and Communist Russia. 3 cr

43.370 Medieval Institutions

An overview of selected political, social, and cultural forms in medieval society. The emphasis is on origins, growth, change, and the interaction of institutions. Topics vary from year to year. 3 cr

43.377 Modern European Imperialism
Motives, methods, and results of imperialism in the nineteenth and twentieth centuries: the partition of Africa and penetration of Asia as contrasting phases in the expansion of Europe. 3 cr

43.380 Work and Society

A survey of labor history from the colonial period to the present focusing on the interrelationships between culture and work in American society and on the dynamics of technical and economic changes on the organization of work processes. 3 cr

43.381 The United States in the 1960s

An examination of the tumultuous decade in which society and politics were torn apart by the civil rights movement, the Vietnam War, and the rise of a counter culture. 3 cr

43.382 The American West

Readings and discussion of the history of the American West and the place of the frontier in American society and thought.

3 cr

43.383 Technology and American Culture

An interdisciplinary study of the interrelationships among technological, economic, social, and cultural forces in America from the colonial era to the early twentieth century. Topics include: three-dimensional thought and pre-industrial empirical technology, the codification and transfer of technology, the beginnings of the American industrial revolution, the development of engineering as a profession, and the emergence of scientific technology. Special emphasis is given to developments in wood-based technologies, water and steam power, textiles, iron and steel, electric communications and power, petroleum, and the internal combustion engine.

3 cr

43.384 Radicalism in American History

A biographical approach to the influence of radicalism on American history with emphasis on significant and representative personalities and their contributions.

3 cr

43.387 The American Indian in the 20th Century

A study of Indian-white relations from the early twentieth century to the present. The course investigates the problems that currently confront Native Americans and their possible solutions; government legislation, agencies and policies that affect American Indians; and the response of tribal government and organizations.

3 cr

43.393 History of the Middle East

An introduction to Islam and the history of the Middle East from Mohammed to the present. The course focuses on Islamic values as they impact upon our own culture and value system.

3 cr

43.420 Twentieth Century Regional and International Organizations

Students take part in a simulation of the proceedings of a regional or international organization, e.g., U.N., O.A.S., O.A.U., or the Arab League. They study all aspects of the selected institution but concentrate on key economic, social, and security issues discussed in the body's debates. The aim of the course is to give students a clearer

understanding of the forces and constraints that shape the foreign policies of individual states.

3 cr

43.432 Research Seminar in History

Systematic research in primary and secondary sources culminating in the writing of an original research paper using proper methodological and stylistic techniques. Weekly meetings and written and oral progress reports. Students must be acquainted with word-processing techniques. Required of all History majors.

3 cr

Directed Studies

Directed Study courses are available only to History majors and may be selected provided that 1) the material to be covered is not available in any course to be offered in the semester in which the directed study is to be taken, 2) instructors are willing to undertake a directed study course, and 3) no more than nine credits in the major field are earned in directed study courses.

43.485 Advanced Tutorial in History

A program of directed study in which the student, through regular consultation with the instructor, develops an evaluative and critical essay. The purpose is to sharpen and refine techniques of scholarly research in the student's major discipline. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor and Chairperson.

3 cr

43.491 Directed Study in History

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, students define and investigate a research topic in an area of special interest and present the results of their investigation in a significant paper. Juniors and seniors only. Prerequisite: permission of instructor and Chairperson.

3 cr

Practicum**43.496 Practicum Experience**

A program of on-campus and off-campus experiences for history majors only. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the

practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson.

3 cr

Department of Languages

Mario Aste, Chairperson

Professor(s): Mario Aste, Joseph Garreau, Heli Hernandez, Herlinda Saitz

Associate Professor(s): Robert Whelan

Assistant Professor(s): Sheryl Lynn Postman

Department Location: Coburn Hall, Room 114

Telephone: (978) 934-4120

The Languages Department focuses on the major intellectual concern of this century and the next—that of communication. Serving as the paradigmatic model for thinking in the human sciences, language occupies a high rung in the conceptualization of numerous disciplines and sign systems. The Department of Languages fosters an understanding of language as a system and a model of communication in its cultural context, in addition to providing skills in a number of languages. The study of languages is a study in the acquisition of perspective and, ultimately, freedom from narrow cultural or disciplinary confines. At the same time, the College recognizes the community contribution of language and cultural programs in the various linguistic groups of the region.

The specific areas of the Department include instruction and study in languages, literature, linguistics and culture.

Language courses are extensively attended by students from other colleges within the University, underscoring the importance and viability of language programs for those in professional, scientific, business and technical fields.

The Department of Languages offers majors leading to the Bachelor of Arts Degree in Modern Languages, with the following concentrations: a) Modern Languages - General, b) Modern Languages, French, c) Modern Languages - Spanish.

Also offered are minors in French, Greek, Spanish; and, in cooperation with other departments, Classical Civilization, Film Studies, German Studies, Italian Studies and Latin American Studies.

Major Requirements

Modern Languages - General

The major in Modern Languages provides varied options for students who are interested in languages, not only from the viewpoint of a possible marketable skill but also as a means of communication with people who speak a language which is different from their own.

A student may combine the Modern Language concentration with other supporting studies, thus tailoring an undergraduate program to meet individual career objectives.

The Modern Language major consists of 36-45 credits above the 100 level (with at least 15 credits at the 300 level or above) and includes the following options:

Option I (French and Spanish)

Option II (French or Spanish) plus another language (Italian or German)

Typically, students earn 24 credits in one language and 12 credits in the other. They may also elect a program with 18 credits in each language.

Students who transfer to the College and who wish to major in Modern Languages must make individual arrangements with the Chairperson regarding satisfaction of major requirements.

Modern Languages - French Option

The French concentration provides a broad liberal arts education for students interested in developing a proficiency in the French language, a general knowledge of the cultural and literary heritage of French civilization, and a basic insight into the function of verbal symbols in the process of human thought. This concentration provides students with sufficient preparation for a career in language teaching or bilingual education or for business or social-service careers requiring a command of the French language. A student may combine the French concentration with other supportive studies, thus tailoring an undergraduate program to meet his/her individual career objectives.

The major in Modern Languages - French consists of 30-45 credits (with at least 15 credits at the 300 course level or above) and normally will include a combination

of 18 credits in language, 12 in literature courses and three credits in culture courses.

50.221	Reading/Conv French I	3 cr
50.222	Reading/Conv French II	3 cr
50.246	Adv French Conversation	3cr
50.310	French Speaking World	3 cr
50.348	Adv French Composition	3cr

Additional coursework beyond the prescribed courses may be elected from the French offerings of the Department to a maximum of 45 credits. Students who transfer to the College and who wish to major in Modern Languages - French must make individual arrangements with the Chairperson regarding satisfaction of major and collateral course requirements.

Modern Languages - Spanish Option

The Spanish concentration provides a broad liberal arts education for students who are interested in developing a proficiency in the Spanish language, a broad knowledge of the cultural and literary heritage of Spanish and Latin American civilization, and a basic insight into the function of verbal symbols in the process of human thought. This major provides students with sufficient preparation for a career in language teaching and bilingual education and for business and social service careers requiring a command of the Spanish language. Students may combine the Spanish concentration with other supporting studies and may tailor their undergraduate program to meet their individual career objectives.

The major in Modern Languages - Spanish consists of 36-45 credits (with at least 15 credits at the 300 level or above) and normally will include 18 credits in language courses, 15 credits in literature courses, and three credits in cultural courses.

54.222	Reading/Conv Spanish II	3cr
54.245	Adv Spanish Conversation	3cr
54.347	Adv Spanish Composition	3cr
54.350	Intro to Literary Analysis	3cr

Additional coursework beyond the prescribed courses may be elected from the Spanish offerings of the Department to a maximum of 45 credits.

Students transferring to the College of Arts and Sciences who wish to major in Spanish must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements.

Minor Requirements

French

A minor area of study consists of 18-24 credits with at least six credits at the 300 or 400 levels. Beginning courses in French at the 100 level may not be credited to the French minor.

Greek

A minor area of studies in Greek consists of 18 semester credits of coursework and must include the following 53.101,102 Beginning Greek I and II, 53.301,302 Greek Classics, and 53.303,304 Selected Greek Authors. Unlike other modern languages, Greek has enjoyed a continuous tradition since antiquity and no break, such as that between Latin and the Romance languages, separates the language of the ancients from the moderns. Educated Greek speakers have always had present in their minds the whole of the language up to their own time. Hence, courses for the Greek minor include literature from all periods—from Homer and Plato to Kazantzakis.

Spanish

A minor in Spanish consists of 18-24 credits with at least six credits at the 300 or 400 levels. Beginning courses in Spanish at the 100 level may not be credited to the Spanish minor. Students who are interested in the application of Spanish to the health professions should take 54.313 Fieldwork in the Spanish Community.

Related Minors

Several interdisciplinary minors related to the study of language are available, including German Studies, Italian Studies, Latin American Studies, and Film Studies. These are described under the heading "Interdisciplinary Minors" at the end of the College of Arts and Sciences section of this catalogue.

Course of Study

General Option

For students entering the University in Fall 1993 and subsequently

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics**(Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Language I Elective	3
	Language II Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science**(Gen Ed)	3
	Historical Studies (Gen Ed)	3
	Language I Elective	3
	Language II Elective	3
		15

Sophomore Year

Fall Semester

	Language I Elective	3
	Language II Elective	3
	Beh & Soc St (Gen Ed)	3
	Science**(Gen Ed)	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Language II Elective	3
	Literature (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Junior Year

Fall Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Science (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Typically, students earn 24 credits in one language and 12 credits in the other as we have outlined here, but they may also elect a program with 18 credits in each language

**Refer to the Academic Policies section in this catalogue for the General Education requirements for mathematics and sciences

Students who transfer to the College and wish to major in Modern Languages must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements

Course of Study

French Option

For students entering in Fall 1993 and subsequently

Freshman Year

Fall Semester

42101	College Writing I (Gen Ed)	3
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50.221	Reading & Conv in French I	3
92.	Mathematics* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
50.222	Reading & Conv in French II	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3
	Free Elective	3
		15

Sophomore Year**Fall Semester**

50.246	Adv French Conversation	3
50.	French Literature Elective	3
	Beh & Soc St (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

50.	French Literature Elective	3
50.	French Culture Elective	3
	Science* (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Junior Year**Fall Semester**

50.310	French Speaking World	3
50.	French Literature Elective	3
	Literature (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

50.348	Advanced French Comp	3
50.	French Literature Elective	3
	Values, C & C (Gen Ed)	3
	Free Elective	3

Free Elective	3
	15

Senior Year**Fall Semester**

300/400	French Elective	3
50.	French Elective	3
50.	French Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

300/400	French Elective	3
300/400	French Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policies section of this catalogue for the General Education requirements for mathematics and sciences.

Course of Study**Spanish Option**

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
54.221	Reading & Conv in Spanish I	3
92.	Mathematics* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
54.222	Reading & Conv in Spanish II	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3
	Free Elective	3
		15

Sophomore Year**Fall Semester**

54.245	Adv Spanish Conversations	3
54.	Spanish Literature Elective	3
	Beh & Soc St (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

54.	Spanish Lit Elective	3
54.	Spanish Culture Elective	3
	Literature (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Junior Year**Fall Semester**

54.350	Intro to Literary Analysis	3
54.	Spanish Literature Elective	3
	Science* (Gen Ed)	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

54.347	Adv Spanish Comp 3	
54.	Spanish Lit Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Senior Year**Fall Semester**

300/400	Spanish Elective	3
54.	Spanish Elective	3
54.	Spanish Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

300/400	Spanish Elective	3
300/400	Spanish Elective	3

Free Elective	3
Free Elective	3
Free Elective	3
	15

*Refer to the Academic Policies section of this catalogue for the General Education requirements for mathematics and sciences.

French Courses (Prefix: 50)

50.101 Beginning French I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who have had more than one year of French at the secondary level may not earn credit for this course. 3 cr

50.102 Beginning French II*

A continuation of 50.101, which is a prerequisite. 3 cr

50.114 French for Business and International Management II

A continuation of 50.101 with a reading emphasis, presenting to Business and Management concentrators and others, by means of a cultural comparison between the French and the American worlds, the terminology and practices of the Francophone business world, particularly in the domains of accounting, banking, management and legal organization. 3 cr

50.211 Intermediate Conversational French I*

Review of basic grammatical structures and idiomatic patterns with emphasis upon increased proficiency in oral expression and aural comprehension. This course is intended for students who have completed two years of high school French, preferably during their junior and senior years, for students who have completed 50.102, and/or for students who are unqualified for the 50.221,222 sequence. 3 cr

50.212 Intermediate Conversational French II*

A continuation of 50.211, which is a prerequisite, with emphasis upon continued comprehension and conversational skills. 3 cr

50.221 Reading and Conversing in French I

Emphasis is upon development of reading and conversational skills, selected contemporary works provide the basis for developing conversational comprehension and composition skills. This course is intended for students who have a solid foundation in the French language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr

50.222 Reading and Conversing in French II

A continuation of 50.221 with emphasis on continued development of reading and conversational skills. Prerequisite: 50.221 3 cr

50.244 Advanced French Grammar and Syntax

A systematic study of grammatical and syntactical structures. Review of more advanced structures. 3 cr

50.246 Advanced French Conversation

Advanced oral practice in rapid and idiomatic speech. Topics of contemporary significance are selected from contemporary prose. 3 cr

50.301 Survey of French Literature I

A survey of French literature based on the history and civilization of France from the Middle Ages to 1800. 3 cr

50.302 Survey of French Literature II

A survey of French literature based on the history and civilization of France from 1800 to the present. 3 cr

50.310 The French-Speaking World

Designed for prospective majors and minors in French as well as for those who have completed four years of high school or two years of college French. The course examines similarities and differences in the ethos of nations of the French-speaking world and in the lifestyles of the individuals and groups that make them up. Conducted in French. 3 cr

50.320 Special Topics in French Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in French. Course content and approach varies, depending on instructor. The Department posts and distributes detailed course descriptions each semester, and students are urged to

use this information in making their selections. 3 cr

50.340 Contemporary French Cinema

A critical appreciation of contemporary French cinema (1985-1995) aiming at sorting out its eclecticism and focusing on the following aspects: 1. The war film and national identity; 2. Representations of sexuality and women filmmakers; 3. The polar and the cinema du look; 4. Filming the arts and the heritage genre. 3 cr

50.348 Advanced French Composition

Designed to impart proficiency in written French through regular exercises in free composition; analysis of literary texts. 3 cr

50.372 Applied Linguistics

Linguistic analysis of French phonology, morphology and syntax, and a comparison of the structures of French and English. Required for perspective teachers of French at the elementary and secondary school levels. 3 cr

50.376 French Cinema and Society

Covers the dramatic presentation French society gives of itself during the period of profound social and economic change, from the New Wave and the May 68 events to today's younger generation facing an uncertain tomorrow. Each screening (in French with subtitles) is preceded by an introduction placing the film in its historical context. In English. 3 cr

50.378 Women in French Cinema

Focuses on the way French film makers (male, and more recently female) have been portraying women in their films. Carefully selected French films with English subtitles are used to show the evolution that has taken place from *Carne* and *Renoir's* poetic realism to the present. Selected readings are also used to underscore various themes, such as how women have been represented in these films. In English. 3 cr

50.401 Selected Authors

An intensive study of works by several French authors. 3 cr

50.432 The Nouveau Roman

An examination of the techniques and procedures of French literature of the 50's and 60's with particular reference to Beckett, Butor, Robbe-Grillet, Sarraute, and Simon. Conducted in French. Prerequisite: permission of instructor 3 cr

50.442 Theatre and Anti-Theatre

The 20th century French Theatre considered as an experimentation in new dramatic forms and as a metaphorical expression of a new vision of life. Plays from major writers (Claudel, Giraudoux, Anouilh, Sartre, Camus, Beckett, Genet, and Ionesco) are analyzed. Conducted in French. Prerequisite: permission of instructor

3 cr

50.454 Techniques of Literary Analysis

Thematic and linguistic analysis of major French prose and poetry of the 19th and 20th centuries. Prerequisite: French concentrators with junior or senior status and others with permission of instructor. Conducted in French.

3 cr

50.456 French Translation Seminar

A study of the theory and practice of translation aimed at developing translation skills. Material used is taken from literary works as well as newspapers and magazines. This course is intended for students with good command of the language. Open to French concentrators and others by permission of instructor.

3 cr

Directed Studies

Directed Studies are available only to French or modern language majors and may be elected provided that 1) the material to be covered is not available in any French course offered during the semester in which directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits in the major field are acquired in directed study courses.

50.491 Directed Studies in French Literature

Individual research projects in French literature. Students, through regular and frequent consultation with their instructor, develop a course of directed study in French literature and define a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor

3 cr

50.492 Directed Study in Composition

Students, through regular and frequent consultation with their instructor, pursue a special program of composition or creative expression. Prerequisite: permission of instructor

3 cr

50.495 Advanced Tutorial in French

A program of directed study which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate a new problem. The purpose of the course is to sharpen and refine techniques for scholarly research, presentation and creative expression. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor

3 cr

Practicum**50.496 Practicum Experience**

A program of on-campus and/or off-campus experiences (for French and Modern Language Majors only). Specific requirements vary depending upon Department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson

German Courses (Prefix: 51)**51.101 Beginning German I***

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who have completed more than one year of German at the secondary level may not earn credit for this course.

3 cr

51.102 Beginning German II*

A continuation of 51.101 which is a prerequisite.

3 cr

51.113 Scientific German I

Introductory course designed for students who wish to acquire facility in translating scientific material from German to English. Introduction to fundamentals of grammar, problems of syntax and idioms with emphasis on scientific terminology.

3 cr

51.114 Scientific German II

A continuation of 51.113 which is a prerequisite.

3 cr

51.211 Intermediate German I*

A review of German grammar and syntax with emphasis upon increased proficiency in reading, aural comprehension and oral expression. This course is intended for students who have completed two years of high school German, preferably during their junior and senior years, or 51.102.

3 cr

51.212 Intermediate German II*

A continuation of 51.211 which is a prerequisite with emphasis upon continued development of comprehension and conversational skills.

3 cr

Directed Studies

Directed studies are available only to Modern Language majors and may be elected provided that 1) the material to be covered is not available in any German course offered during the semester in which the directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits of the modern language major are acquired in directed study courses.

51.491 Directed Study in German Literature

Individual research projects for modern languages. Students through regular and frequent consultation with their instructor develop a course of directed study in German literature and define a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor

3 cr

51.492 Directed Study in German Composition

Individual research projects for Modern Language majors. Students through regular and frequent consultation with their instructor pursue a special problem of composition or creative expression. Prerequisite: permission of instructor

3 cr

51.495 Advanced Tutorial in German

A program of directed study which affords Modern Language majors an additional opportunity to pursue a previously explored topic in greater depth or to initiate an additional topic. The purpose of this tutorial is to sharpen and refine tech-

niques of scholarly research, presentation and creative expression. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum

51.496 Practicum Experience

A program of on-campus and/or off-campus experiences (for modern language majors only) which are developed by the student in consultation with a member of the German faculty. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the modern language concentration. May be repeated for a maximum of nine credits in practicum courses. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson 3 cr

Greek Courses (Prefix: 55)

55.101 Beginning Greek I*

No previous knowledge of Greek required. The aims are basic oral expression, aural comprehension, and elementary reading and writing in modern and ancient Greek. 3 cr

55.102 Beginning Greek II*

Continuation of 55.101 with readings in Greek prose and poetry. The course provides a foundation for advanced study in modern or classical Greek. Prerequisites: 55.101 or equivalent and permission of instructor 3 cr

55.211 Intermediate Greek I*

Review and development of audio-lingual skill, writing and reading in Greek, followed by the reading of Greek texts from the classical, Byzantine and modern periods. Prerequisites: 55.101, 55.102 or equivalent and permission of instructor 3 cr

55.212 Intermediate Greek II*

Continuation of 55.211. 3 cr

55.301 Greek Classics I

Concentrated readings of Homer, Herodotus, Xenophon, Plato and the dramatists. Prerequisites: 55.212 or equivalent and permission of instructor 3 cr

55.302 Greek Classics II

Continuation of 55.301. Prerequisites: 55.212 or equivalent and permission of instructor 3 cr

55.303 Selected Greek Authors

Intensive study of a few works of an author not previously studied. May be repeated for credit with approval of instructor. 3 cr

55.310 Special Topics in Greek Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or Greek. Course content and approach varies depending on instructor. The Department posts and distributes a detailed course description each semester, and students are urged to use this information in making their selections. 3 cr

The following courses are conducted in English and do not satisfy any language requirement.

55.251 Great Books of Ancient Greece

A study in the meaning and importance of the Greek masterpieces, which are read in the best translations available. (Subject to demand of classical civilization minors.) 3 cr

55.252 Great Books of Ancient Greece

Continuation of 55.251. Subject to demand of classical civilization minors. 3 cr

55.351 Classical Drama

Group readings of great plays; discussion of their meaning and importance; lectures on the Greek Theatre; the origins of tragedy and comedy, the nature of drama, and the special achievements of each dramatist. Prerequisite: permission of instructor (Subject to demand of classical civilization minors.) 3 cr

55.451 Greek Thought

The Greek view of man and nature as revealed in myth, philosophy, science, history, art, and literature, and their relation to the modern age. (Subject to demand of classical civilization minors.) Prerequisite: permission of instructor 3 cr

Italian Courses (Prefix: 52)

52.101 Beginning Italian I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who completed more than one year of Italian at the secondary level may not earn credit for this course. 3 cr

52.102 Beginning Italian II*

A continuation of 52.101, which is a prerequisite. 3 cr

52.211 Intermediate Italian I*

A review of Italian grammar and syntax with emphasis on increased proficiency in reading, aural comprehension, and oral expression. This course is intended for students who have completed two years of high school Italian, preferably during their junior and senior years, or 52.102. 3 cr

52.212 Intermediate Italian II*

A continuation of 52.211 which is a prerequisite with emphasis upon continued development of comprehension and conversational skills. 3 cr

52.310 Special Topics in Italian Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or Italian. Course content and approach varies depending on instructor. The Department posts and distributes a detailed course description each semester, and students are urged to use this information in making their selections. 3 cr

The following courses are conducted in English, do not satisfy any language requirement and cannot be counted as part of the Modern Language major.

52.325 Italian American Literature and Culture

Discusses the most prominent authors and works of Italian American Literature as they, by using the ethnic setting are able to convey universal human concerns and themes. Conducted in English. 3 cr

52.330 Italian Women Writers

Studies women writers of Italy by giving attention to the genres of narrative, poetry, theater and autobiography. Authors are selected according to their impact on issues affecting women, gender studies,

feminism, avantgarde, modernism, social relations and psychological discourse. Conducted in English. 3 cr

52.335 Cinema and the Italian Americans

A course looking at the ways in which film addresses issues of ethnicity and its representation in the multi-ethnic and multi-cultural memory of American life. This will be an interdisciplinary course focusing on the relentless portrayal in the news and entertainment industries of Italian Americans. It will shed light on the contributions of this ethnic group by analyzing the negative and positive stereotypes through films. 3 cr

52.371 Dante's Divine Comedy

A detailed study of the Divine comedy. Consideration is given to the influence of Dante's minor works, to the unity of the poem as a synthesis of Dante's new life, and to Dante's views of the world and history. Conducted in English. 3 cr

52.373 Italian Humanism

A study of the waning of the Middle Ages and the dawning of the Renaissance as seen through the work of Petrarch and Boccaccio. Emphasis is on the study of sources and the influence of Petrarch and Boccaccio upon the literatures of western Europe. Conducted in English. 3 cr

52.374 Classics of Italian Cinema

This course, through a series of classic Italian films, internationally recognized, will present how the style is not only something which comes from within the director reflecting that most intriguing of all subjects: the personality of the director, but also the film's influence upon American productions. 3 cr

52.376 Pirandello: His Theater and Influence

A course devoted to the major works of Pirandello which have established his reputation as an entertainer and a social critic with special emphasis upon his notion of appearance vs. reality and his influence upon contemporary French drama. Conducted in English. 3 cr

52.378 Italian Cinema and Culture

A guide to contemporary Italian studies through literary and cultural approaches. The works of central figures in contemporary Italian letters are examined in view of their impact on Italian life. Emphasis is

given to poets, novelists, the new cinema, the influences of existentialism, and the impact of America on Italian literature. Conducted in English. 3 cr

52.380 Italian Cinema: Directors and Themes

A study of Italian film history and its accomplishment by exploring the relationship of cinema to socio-political, economic, cultural and literary events. The course will discuss in depth either a) one or two major and well known directors; b) a major thematic and stylistic division in a century of cinematic creativity. 3 cr

Directed Studies

Directed studies are available only to Modern Language majors and may be elected provided that 1) the material to be covered is not available in any Italian course offered during the semester in which a directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits of the Modern Language major are acquired in directed study courses.

52.491 Directed Study in Italian Literature

Individual research projects for modern language majors. Students, through regular and frequent consultation with their instructor, develop a course of directed study in Italian literature and define a subject for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

52.492 Directed Study in Italian Composition

Individual research projects for modern language majors. Students, through regular and frequent consultation with their instructor, pursue a special topic of composition or creative expression. Prerequisite: permission of instructor 3 cr

52.495 Advanced Tutorial in Italian

A program of directed study which affords Modern Language majors with an additional opportunity to pursue a previously explored topic in greater depth or to initiate additional ones. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum

52.496 Practicum Experience

A program of on-campus and/or off-campus experiences (for Modern Language majors only) which are developed by the student in consultation with a member of the Italian staff. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skill which are appropriate to the modern language concentration. May be repeated for a maximum of nine credits in the practicum courses. Students are graded "satisfactory" or "unsatisfactory." The practicum may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson 3 cr

Latin Courses (Prefix: 56)

56.101 Beginning Latin I*

A course for beginners and for students wishing to review the elements of Latin and to acquire, thereby, an ability to read selected passages from Latin authors. 3 cr

56.102 Beginning Latin II*

Continuation of 56.101 with special attention devoted to the translation, analysis, and class discussion of selected passages from Latin authors illustrating the life, culture, and contribution of ancient Rome to the modern world. 3 cr

56.211 Intermediate Latin I*

Readings from Latin prose and poetry with special attention to the works of such authors as Cicero and Virgil. Prerequisites: 56.101, 102 3 cr

56.212 Intermediate Latin II*

Continuation of 56.211. 3 cr

56.301 Latin Classics I

Concentrated readings in such authors as Livy, Tacitus, Horace, Juvenal, Catullus, Ovid, and medieval Latin writers. Prerequisites: 56.101, 56.102, or four years of high school Latin 3 cr

56.302 Latin Classics II

Continuation of 56.301. 3 cr

56.303 Selected Latin Authors

Intensive study of a few works by an

author not previously studied. May be repeated for credit with approval of instructor. 3 cr

56.310 Special Topics in Latin Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Latin. Course content and approach vary depending on instructor. The Department will post and distribute a detailed course description when appropriate. 3 cr

56.352 Classical Drama

Continuation of 55.351 with concentration on the Roman dramatists. Prerequisite: permission of instructor (Subject to demand of classical civilization minors.) 3 cr

56.451 The Roman Mind

The Roman view of man and nature as revealed in law, government, social institutions, legend and religion, and their relation to the modern world. Prerequisite: permission of instructor. (Subject to demand of classical civilization minors.) 3 cr

Spanish Courses (Prefix: 54)

54.101 Beginning Spanish I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who completed more than one year of Spanish at the secondary level may not earn credit for this course. 3 cr

54.102 Beginning Spanish II*

A continuation of 54.101 which is a prerequisite 3 cr

54.103 Conversational Spanish for Health Professions

Fundamental skills in conversation for the health professions (semi-technical functional vocabulary, idiomatic expressions used by patients and doctors, and situational phrases for the health professions) with special emphasis upon those cultural and physiological characteristics of the Spanish speaking world. 3 cr

54.114 Spanish for Business and International Management

A continuation of 54.101 for business and management concentrators and others, with a reading emphasis, showing cultural comparisons between the Hispanic and

the American worlds in the terminology and practices of the Hispanic business world, particularly in the domains of accounting, banking, management and legal organization. 3 cr

54.211 Intermediate Conversational Spanish I*

A review of Spanish grammar and syntax with emphasis upon increased proficiency in aural comprehension and oral expression. This course is intended for students who completed two years of high school Spanish, preferably during their junior and senior years, for students who completed 54.102, and for students who are unqualified for the 221.222 sequence. 3 cr

54.212 Intermediate Conversational Spanish II*

A continuation of 54.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. Required of Spanish concentrators 3 cr

54.213 Intermediate Conversational Spanish III*

Designed for Criminal Justice majors, this course may replace 54.212, the second portion of the intermediate sequence.

Continued development of comprehension and conversational skills are emphasized. Students work with relevant technical vocabulary and highly idiomatic "street" language. Cultural information emphasizes characteristics of the Spanish-speaking population in the United States. 3 cr

54.221 Reading and Conversing in Spanish I

Basic emphasis is upon Spanish grammar review and the development of reading and conversational skills. Selected contemporary works provide the basis for developing conversational comprehension and conversational and composition skills. This course is intended for students with a solid foundation in the Spanish language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr

54.222 Reading and Conversing in Spanish II

A continuation of 54.221 which is a prerequisite with emphasis on continued development of reading and conversational skills. Required of Spanish concentrators. 3 cr

54.234 Adv Spanish Grammar & Syntax

A systematic study of complex grammatical and syntactical problems. Review of more advanced problems. 3 cr

54.245 Advanced Spanish Conversation

Advanced oral fluency in rapid, idiomatic speech. Topics of contemporary significance are selected from contemporary prose. Required of Spanish concentrators. 3 cr

54.254 Topics in Conversational Spanish

Discussion of a wide spectrum of contemporary topics with the object of continuing to develop facility and accuracy of expression. Prerequisite: advanced level proficiency 3 cr

54.301 Intro to Spanish Literature

The history of Spain's literature studied in its general trends and through its major writers revealing the complicated series of interactions, conflict and influences which have molded the unique character of the nation. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.302 Intro to Latin American Lit

A study of the major writers of Latin America from the indigenist literature to the modernist period. The authors and their works are placed in their historical, sociological, and literary perspective, thus introducing students to the Latin American world. Conducted in Spanish. Prerequisite: permission of instructor required 3 cr

54.310 Spanish Civilization and Culture

Considers Spanish culture and civilization up to the present. Through audiovisual aids, current newspapers and selected readings the student explores the Spanish way of being, thinking, and living. Emphasis is on the main contributions of Spain to the Western world. 3 cr

54.313 Fieldwork in the Spanish Community

Individual assignments under the sponsorship of local service agencies servicing the Spanish speaking community involving individual family and group contact. Written and oral reports in Spanish. Prerequisite or corequisite: 54.212 or equivalent 3 cr

54.315 Latin American Civilization and Culture

Considers significant intellectual, artistic, historical and socio-political aspects of Latin American from the beginning of its history. Through audiovisual aids and selected readings, the student explores the Latin American way of being and expressing. 3 cr

54.320 Special Topics in Spanish Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Spanish. Course content and approach vary depending on instructor. The Department posts and distributes detailed course descriptions each semester, and students are urged to use this information in making their selections. Prerequisite: permission of instructor required 3 cr

54.330 Spanish and Latin-American Women Writers

Studies women writers of the Spanish-speaking world from the XVI century to the present. Emphasis is given to their contribution to the development of Spanish literature and culture as well as their vision of the world and their concerns for the rights of women. Among the writers studied are Santa Teresa de Jesus, Sor Juana Ines de la Cruz, Emilia Pardo Bazan, Carmen de Burgos, Silvina Ocampo, Elena Garro, Armonia Somers, Marta Lynch and Victoria Ocampo. Conducted in Spanish. 3 cr

54.347 Advanced Spanish Composition

Designed to help the mature language student recognize and interpret a variety of literary styles. Also designed to develop self-expression and facility in prose writing. Required of Spanish concentrators. 3 cr

54.350 Intro to Literary Analysis

Focuses on acquiring the technical vocabulary, concepts and methods of literary criticism. Through the analysis of selected Spanish literary works, the student gains an understanding of the different literary genres as well as a knowledge of their structures and artistic qualities. Required for all Spanish concentrators. 3 cr

54.372 Applied Linguistics

Linguistics analysis of Spanish phonology, morphology, and syntax with a systematic comparison of the structures of Spanish

and English. Required for prospective teachers of Spanish in the elementary and secondary schools. 3 cr

54.401 Selected Authors

An intensive study of works by a few Spanish and/or Latin American authors. 3 cr

54.403 The Golden Age

A study of the development and character of XVIIth century Spanish drama, novel and poetry with special emphasis on Cervantes, Lope de Vega, Calderon and Quevedo. An analytical study of some of the masterpieces from structural and stylistic points of view, taking into consideration their relation to the period and the expression of universal values. Prerequisite: 54.350 or permission of instructor 3 cr

54.404 Cervantes

Study of the works of Cervantes. Complete analysis and readings of either the Don Quijote and/or other works including but not limited to the short stories and the one act plays. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.405 The Generation of '98

A critical study of such influential authors as Unamuno, Valle-Inclan, Baroja, Azorin, and Machado. Special emphasis is given to their influence upon the emergence of modern Spain. Prerequisite: 54.350 or permission of instructor 3 cr

54.407 Spanish Picaresque Novel

Analysis of representative works of the picaresque genre, its portrait of Spanish society and social criticism. Emphasis is placed on Ellazarrillo de Tormes, Guzman de Alfarache, El Buscon and Riconete y Cortadillo. Prerequisite: 54.350 or permission of instructor 3 cr

54.409 Twentieth Century Spanish Lit

A study of the famous generation of 1927 and of the major literary trends during and after the Spanish Civil War. Prerequisite: 54.350 or permission of instructor 3 cr

54.410 Realism and the XIX Century Spanish Novel

A study of fundamental aspects of life, thought, land itself and its sense of history as reflected in the literary masterpieces of Valera, Galdos, Alarcon, Pereda and others. An analysis of the literary techniques and fiction of Realism is included.

Prerequisite: 54.315 or permission of instructor 3 cr

54.412 Short Story in Latin America

An analytical examination of the thematic and linguistic structures of major Latin American short story writers such as Borges, Cortazar, Marquez, Rulfo. Prerequisite: 54.350 or permission of instructor 3 cr

54.416 The Latin American Novel

The study of the development of the Latin American novel. Three major works (Doña Barbara, Los de Abajo, and Don Segundo Sombra) are read, analyzed in depth, and placed in the historical context of the novel in Latin America. Prerequisite: 54.350 or permission of instructor 3 cr

54.450 Twentieth Century Spanish Essay

Spanish essay of the twentieth century considered in the context of changes in modern Spain. Authors include Ortega y Gasset, Lain Entralgo, Marias and Ayala. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.451 Nineteenth and Twentieth Century Latin American Essay

Latin American essays of the nineteenth and twentieth century. Among the authors studied are Montalvo, Bolivar, Bello, Rodo, Henriquez Urena, Vasconcelos, Alfonso Reyes and German Arciniegas. 3 cr

54.456 Spanish Translation Seminar

A study of the theory and practice of translation aimed at developing translation skills. Material used is taken from literary works as well as newspapers and magazines. This course is intended for students with a good command of the language. Open to Spanish concentrators and others by permission of instructor 3 cr

Directed Studies

Directed Study are available only to Spanish or Modern Language majors and may be elected provided that 1) the material to be covered is not available in a Spanish course offered during the semester in which a directed study course is contemplated, 2) instructors are willing to undertake a directed study course, and 3) no more than nine credits in the major field are acquired in directed study courses.

54.491 Directed Study in Spanish Lit
Students, through regular and frequent consultation with their instructor, develop a course of directed study in Spanish literature and define a program for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

54.492 Directed Study in Latin American Literature
Students, through regular and frequent consultation with their instructor, develop a course of directed study in Spanish literature and define a program for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

54.493 Directed Study in Composition
Students, through regular and frequent consultation with their instructor, pursue a special program of composition or creative expression. Prerequisite: permission of instructor 3 cr

54.495 Advanced Tutorial in Spanish
A program of directed study which affords advanced students an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation and for creative expression. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum

54.496 Practicum Experience
A program of on-campus and/or off-campus experiences for Spanish or Modern Language majors only. Specific requirements vary depending upon Department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required

course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

*Beginning and intermediate language courses at the 101,102 and 211,212 levels must be elected for two consecutive semesters and in the prescribed sequence. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of placement in a more advanced language course.

Legal Studies Program

William J. Burke, Coordinator

Professors: William J. Burke, Michael Jones

Associate Professors: Russell Karl

Department Location: Falmouth Hall, Room 302

Telephone: (978) 934-2780

Most of the nation's law schools reject the idea of a rigid pre-law curriculum as a means of preparing for entrance into law school. The undergraduate pre-law student is actually working toward two different objectives: vigorous academic preparation for law school and an undergraduate education that will complement the law degree once obtained.

The type of undergraduate degree pursued may depend on the type of law in which you intend to specialize. For example, if you want to become a tax attorney, you might concentrate in accounting and economics. If copyright law interests you, an undergraduate degree in music or art would be beneficial. Those students interested in law school as a prelude to government service or politics may want to pursue an undergraduate degree in political science. Many students do not have a particular field of law identified prior to entering college. For such students, a broad liberal arts preparation is important. All pre-law students should be aware that communications skills are very important, and for this reason, courses in English, speech, and foreign languages should be considered.

Legal Studies Minor

The Legal Studies Minor is a program offered by the Legal Studies Department that allows the student to gain a valuable insight into substantive law courses. Many of the Legal Studies courses serve as previews to the courses offered in law schools.

In order to earn a Legal Studies Minor, the student must file with the Office of Enrollment Services, an Academic Petition approved by the Legal Studies Coordinator. A Legal Studies Minor consists of a minimum of 18 credits chosen

from the Legal Studies courses (41 prefix). Note that only one of the introductory courses (41.261, 41.262) may be credited toward the minor.

Professors of Legal Studies, in their advisory roles, will tailor the student's Legal Studies Minor to complement the student's major. For example, an Accounting major might take the following as his or her Legal Studies courses: Introduction to Business Law, Corporate and Property Law, Law for the CPA and Pre-Law Student, The Legal Environment of Business, Business Planning, and Federal Income Tax Law.

Six of the following courses are required for the Legal Studies Minor. Only one of the introductory courses (41.261, 41.262) may be credited toward the minor. For further information, inquire at the Legal Studies Office in Falmouth 302.

- 41.234 Criminal Law
- 41.261 Introduction to Legal Concepts
- 41.262 Introduction to Business Law
- 41.360 Legal Issues in Racism
- 41.363 Corporate and Property Law
- 41.364 Law for the CPA and Pre-Law Student
- 41.365 The Legal Environment of Business
- 41.366 International Law
- 41.367 Environmental Law
- 41.368 Employment and Labor Law
- 41.369 The Courts and the Constitution
- 41.370 Real Estate Law
- 41.371 Legal Issues in Health Care
- 41.372 Sports & Entertainment Law
- 41.373 Consumer Law
- 41.374 Computers and the Law
- 41.375 Securities Regulation
- 41.376 Family Law
- 41.377 Practice Law for the Individual
- 41.378 Comparative European Community Law
- 41.379 The Relationship of Law, Logic, and Ethics
- 41.380 Marketing's Fifth P-Prosecution

and Legal Restriction

- 41.381 Women and the Law
- 41.382 Business Planning
- 41.383 Alternative Dispute Resolution
- 41.384 State and Local Taxation
- 41.385 Immigration Law
- 41.386 Intellectual Property
- 41.387 Legal Research Methods
- 41.390 Litigation
- 41.391 Federal Income Tax Law
- 41.395 Bankruptcy Law
- 41.488 Directed Study in Law
- 41.489 Seminar in Law

Legal Studies Courses (Prefix: 41)

41.234 Criminal Law

This course is a study of substantive criminal law, with emphasis on general principles of criminal culpability, such as the act requirement, the mens rea requirement, and causation. The course will also cover the law of attempted crimes, accomplice liability, and defenses. The elements of specific crimes, such as homicide, burglary, robbery, and larceny will be studied in depth. 3 cr

41.261 Introductory Legal Concepts

An introductory legal course. It is a survey of many specific topics such as product liability, consumer law, intellectual property, and ethics. More importantly the course emphasizes critical legal thinking and human values. 3 cr

41.262 Intro to Business Law

Introduces the student to the fundamentals of criminal and tort law. The main emphasis is on all aspects of contract law including the agreement, consideration, the writing third party rights, illegality, performance, and remedies. Also covered is agency law concerning all situations where one party is working for another in the business world. This course is highly recommended for pre-law students, CPAs and paralegals. 3 cr

41.360 Legal Issues in Racism

A study of racial discrimination in the United States. Emphasis will be placed on relevant constitutional provisions, statuto-

ry provisions, and on U. S. Supreme Court cases. 3 cr

41.363 Corporate and Property Law

This course studies the law and its impact on the business world. Partnerships, limited partnerships, and joint ventures are studied at the outset of the course. The main emphasis is on elements of the corporate structure. The last part of the course deals with personal and real property with coverage of wills and trusts. This course is highly recommended for pre-law students, CPAs and paralegals. 3 cr

41.364 Law for the CPA and Pre-Law Student

This course is recommended for the senior level student, especially those students studying for the CPA exam and for those students preparing for law school. The course deals exclusively with the Uniform Commercial Code, including sales, bills, notes, secured interests, and bulk sales. Prerequisite: one prior legal studies course or permission of the instructor 3 cr

41.365 The Legal Environment of Business

This course deals with the manager's role in understanding and determining the firm's relations with government and society. Topics relating to government include the tax and regulatory provisions of local, state and federal agencies. Some of the regulatory provisions studied include provisions governing licensing and mergers. The antitrust laws are also examined. Topics relating to society include the social cost of business, civil rights, business ethics, and problems in ecology. 3 cr

41.366 International Law

This course is recommended at the senior level. Students are introduced to the body of international rules, customs and regulations which are in force between nations. Specific legal issues involving a study of multinational cultural, political, economic and ethnic perspectives are addressed. Topics include human rights, war prevention, foreign policy, tort and criminal liability, business trade practices, and dispute settlement. 3 cr

41.367 Environmental Law

Examines the legal and administrative problems of protecting the quality of the human environment. Federal and state legislation on environmental policy is studied. "Public interest" litigation as a supple-

ment to the enforcement of environmental law is discussed. Places emphasis on the law as a means of protecting the environment. 3 cr

41.368 Employment and Labor Law

Discusses legislative and judicial decisions and the Department of Labor's administrative rulings relative to the management-labor process. Reviews the sources of labor law and employer and union unfair labor practices. Emphasizes the Occupational Safety Health Act, the Civil Rights Act, the Equal Opportunity Act, and the National Labor Relations Act. 3 cr

41.369 The Courts and the Constitution

Focuses on the separation of powers of the national government and the limitation of national power to preserve a degree of autonomy in the states. These dispersions of power which have guaranteed fundamental individual liberties are examined by reading leading U.S. Supreme Court cases. Students will explore how their freedoms to make moral choices are affected by the law of the constitution. 3 cr

41.370 Real Estate Law

Includes in its treatment contracts for the sale of real estate, deeds, title examinations, security for real estate transactions, methods and problems of co-ownership, zoning ordinances, brokerage contracts, leases and landlord and tenant rights and liabilities. 3 cr

41.371 Legal Issues in Health Care

This course examines the law of private and public health care. The rights and responsibilities of the health care professional to patient and society are investigated. Current health, political, economic, legal and societal issues affecting government, individuals, health care providers and insurance carriers are reviewed. 3 cr

41.372 Sport & Entertainment Law

This course explores the legal issues that arise in the sports and entertainment industry. In the amateur sport setting the legal relationships between athletes, coaches, schools and athletic associations are examined in depth. Contract law, federal labor and anti-trust regulations are reviewed to define the rights and responsibilities of the various participants in the professional sports arena. 3 cr

41.373 Consumer Law

Acquaints the student with current federal and state consumer protection statutes. Deals with individual consumer problems by discussing deceptive advertising and the legal effect of warranties. Delves into the law pertaining to consumer credit including unfair debt collection tactics. Investigates insurance law as it affects consumers and surveys the law protecting incompetent consumers. Examines the legal remedies available to consumers including the consumer class action. 3 cr

41.374 Computers and the Law

Provides an introduction into the common areas of the law related to the acquisition and use of computer goods and services. Deals with computers and constitutionally-protected private rights, computer crimes, computer torts and contracts. Methods of protecting software development such as copyright, patent, trade secrets and program licensing are explained and discussed. Introduces legal research using a computer. 3 cr

41.375 Securities Regulation

Discusses within a legal context the roles and ethical considerations of corporate management, the underwriter, CPA, directors and "insiders." The nature of a security, the registration process, exemptions from registration and civil liability are explained within the Securities Acts and regulations promulgated thereunder by the Securities and Exchange Commission. 3 cr

41.376 Family Law

The critical family law issues facing society today are studied. Subject matter examined includes the law of marriage, custody, adoption, divorce, child support, juveniles, right to die, fetal tissue transfer to prolong the life of another, reproduction control and surrogate parenting. This course is taught from a legal and human values perspective. 3 cr

41.377 Practice Law for the Individual

Survey course of the law for the student taking only one law course for a practical purpose. It will focus on common problems that are encountered in the real world such as landlord tenant relationships, buying your first home, wills, trusts, insurance contracts, and simple contracts as well as bankruptcy and divorce. 3 cr

41.378 Comparative European Community Law

This course deals with the relationship between European Community law and the law of the United States; the operation and impact of community law in the United States; and the role of the European courts in interpreting community law. International treaties, laws, and regulations affecting the free movement of people, goods and services are traced. 3 cr

41.379 The Relationship of Law, Logic and Ethics

This course examines the impact of ethical viewpoints on the structure of legal doctrines. It stresses the fact that the study of law is a study of ethics as well as logic. 3 cr

41.380 Marketing's Fifth P - Prosecution and Legal Restriction

Increasing legal prosecution and Government intervention are influencing marketing decision making. As law becomes ever more intrusive, knowing how to avoid problems and how to make the system work for the company can pay off handsomely. The course will cover such topics as sales promotion tactics, the do's and don'ts of advertising, Antitrust laws, postal restrictions, product trademarks, taxes and restrictions, franchises, warranties, guarantees and U.S. restrictions on doing business abroad. 3 cr

41.381 Women and the Law

Covers issues that particularly affect women. Topics include: sex discrimination, sexual harassment, marriage, divorce, reproductive control, surrogate motherhood, and child custody. 3 cr

41.382 Business Planning

General survey of the basic factors to be considered in the organization, financing, operation and liquidation of the small business venture. These factors will be examined within a choice of business entity frameworks. Proprietorships, partnerships, business trusts, close corporations and professional corporations will be covered. There will be an emphasis on federal taxation of these entities. 3 cr

41.383 Alternative Dispute Resolution

The traditional trial is becoming increasingly rare in modern civil litigation; the large majority of disputes are resolved by

other techniques. This course will examine alternative methods of dispute resolution such as negotiation, mediation, arbitration and the mini trial. 3 cr

41.384 State and Local Taxation

The development of the state and local tax systems with particular emphasis on recent Massachusetts changes in real and personal property taxation as well as business taxes; consideration of the uniformity and equality requirements of both state and federal constitutions; and emphasis on the assessment and collection of taxes, and the taxpayer's legal remedies concerning tax abatements. 3 cr

41.385 Immigration Law

A study of the immigration, nationality, and naturalization laws of the United States. The topics discussed are: the immigrant selection system, the issuance of immigrant and non-immigrant visas; grounds of excludability of aliens and waiver of excludability; grounds for deportation of aliens and relief from deportation; and change of status within the United States including legalization, refugee and asylum status. 3 cr

41.386 Intellectual Property

A survey of the law of the protection of ideas, trade secrets, inventions, artistic creations, and reputation. The course will briefly review the bases for patent, trademark, copyright and trade secret protection, the distinction between the various forms of intellectual property, and the statutory and common law methods of enforcing rights. 3 cr

41.387 Legal Research Methods

This course is designed to introduce the student to the fundamentals of legal research and writing. The student will gain hands-on experience in legal research and in the reporting of such research in case briefs and memoranda. Emphasis will be placed on the case law on the case law and statutory law of the Commonwealth of Massachusetts. 3 cr

41.390 Litigation

Examines the practices and procedures involved in the litigation process. Topics include: legal research, courts and jurisdictions, evidence, discovery, pleadings, motions, depositions, trials and appeals, and the federal rules of procedure. 3 cr

41.391 Federal Income Tax Law

The course is an introduction to the fundamentals of federal income tax law. Students will become familiar with the provisions of the Internal Revenue Code dealing with the identification of income subject to taxation, and deductions. 3 cr

41.395 Bankruptcy Law

This course will involve itself with the study of Federal and State Statutes concerning credit lending, business bankruptcy, individual bankruptcy, protective trust devices, and credit report implications of bankruptcy. 3 cr

41.488 Directed Study in Law

Permits superior students to engage in specialized study. Prerequisite: permission of Legal Studies Coordinator. 3 cr

41.489 Seminar in Law

Provides opportunity for small groups of advanced students to study selected topics. Prerequisite: permission of Legal Studies Coordinator. 3 cr

Graduate Courses in the Legal Studies Department

41.602 Law and Society

An introduction to the study of law and the legal environment in which it functions. This course covers the elements of macro-law (governmental agencies and law) as well as micro-law (private historical law). Topics include product liability, employment law, business ethics, contract law, security regulation, business organization, and the uniform commercial code section that has been internationalized. 3 cr

41.610 The Regulatory Environment

Strictly focuses on the law of government regulation of business activity. Topics include administrative law, discrimination in the work place, mandating universal health care, drug testing and rights to privacy, protecting corporate secrets, regulation of markets, criminal law in the boardroom and bankruptcy. A case approach is used. Prerequisite: 66.602 3 cr

41.620 Property Law

The general principles of the law of property and legal requirements for acquiring and transforming different property interests. Leases, bailments, cooperatives, real estate agents, condominium law, and land

use regulation. Trust and wills are emphasized. 3 cr

41.670 International Law

Recommended at the senior level. Students are introduced to the body of international rules, customs and regulations which are in force between nations. Specific legal issues involving a study of multinational cultural, political, economic and ethnic perspectives are addressed. Topics covered include human rights, war prevention, foreign policy, tort and criminal liability, business trade practices, and dispute settlement. Prerequisite: 66.602 3 cr

41.680 Constitutional Law

Focuses on the separation of powers of the national government and the limitation of national power to preserve a degree of autonomy in the states. These dispersions of power which have guaranteed fundamental individual liberties are examined by reading leading U.S. Supreme Court cases. Students will explore how their freedoms to make moral choices are affected by the law of the constitution. 3 cr

41.685 Employment and Labor Law

Examines sources of labor. Discusses legislative and judicial decisions and the Department of Labor's administrative ruling relevant to the management labor process. Reviews the sources of labor law and employer and union unfair labor practices. Emphasizes the Occupational Safety Health Act, the Civil Rights Act, the Equal Employment Opportunity Act and the National Labor Relations Act. 3 cr

41.690 Environmental Law

Examines: 1) the new environmental regulating law and policies; 2) joint federal-state enforcement; 3) international environmental law developments; 4) significant judicial and administrative cases; and 5) integrating environmental consideration and costs into planning decisions. 3 cr

41.695 Current Topics in Law

Selected topics having current and future impact on the law. Prerequisite: 66.602 3 cr

Liberal Arts

John McCaffrey, Program Coordinator

The Liberal Arts major results in the degree of Bachelor of Liberal Arts. The major requires students to concentrate in two disciplines in the humanities and social sciences. Each concentration requires a minimum of eight and a maximum of ten courses, at least four of which must be at the 300 or 400 level. In addition, students must fulfill either a foreign language or a computer skill requirement.

The Bachelor of Liberal Arts (BLA) program addresses the needs of several sizeable student constituencies. It appeals to students who are undecided about a major but who know they want a broad-based liberal arts education. It has become especially attractive to students who plan to attend graduate schools of education in preparation for a career in teaching. The program also is appropriate for older students, many of whom are particularly interested in inter-disciplinary studies, and for transfer students, particularly those from the state's community colleges.

The Bachelor of Liberal Arts is a baccalaureate degree program offered only to fine arts, humanities, and social science students in the College of Arts and Sciences. The essence of the BLA degree is that the student takes two disciplinary concentrations of 8 to 10 courses each. The degree offers students curricular flexibility and a broad background in the humanities and social sciences. All courses should be selected in consultation with the director of the BLA program.

Specific degree requirements are:

1. a total of 48 to 60 credit hours in the Humanities and Social Sciences, distributed as follows: Two concentrations of 8 to 10 courses (24-30 credit hours) each, with at least half at or above the 300 level;
2. under ordinary circumstance a minor will not be permitted;
3. students may choose to fulfill either a foreign language or a computer skills requirement; and

4. in the junior year, Essay Writing for Non-Majors is required.

The following concentrations have been approved for the Bachelor of Liberal Arts Degree:

Art History
Comparative Arts
Developmental Disabilities (Psychology)
Economics
English
 Literature
 Writing
Gender Studies
History
Languages
Legal Studies
Philosophy
Political Science
Psychology
Sociology
Theater Arts

Art History Concentration

The art history concentration is designed to develop and foster historical, aesthetic and multicultural appreciation of art as well as analytical, critical and theoretical knowledge of art. An art history concentration in the Bachelor of Liberal Arts consists of 24-30 credits (8 to 10 courses) distributed with the following requirements; all courses are selected in consultation with the Art History Coordinator:

1. Two Foundations of Art History courses (6 credits)

Survey of Art I and Survey of Art II

(All art history students must take Survey of Art I and II prior to enrolling in the upper level art history courses.)

2. Art History Electives (15 to 18 credits or five to six courses, from this selection, must be at the 300 level and above)
3. Practicum in Art History (3 credits or one to two courses)
4. In the junior year Essay Writing for Non-Majors is required for all Bachelor of Liberal Arts students

Reading knowledge of a foreign language is strongly encouraged.

Department of Mathematical Sciences

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(For up-to-date information visit the Mathematical Sciences Web page at <http://www.uml.edu/Dept/Math.>)

Vidhu Prasad, Chairperson

Professors: Shimshon Berkovits, Charles L. Byrne, Alan W. Doerr, M. Brendan Fleming (Emeritus), Enrique Gonzalez-Velasco, Lee K. Jones, Gerald Kaiser (Emeritus), Kenneth M. Levasseur, Yuly Makovoz, Gerald A. Paquette (Emeritus), Vidhu Prasad, Mary Beth Ruskai, Alexander Samarov, Bernard Shapiro (Emeritus), Virginia S. Taylor (Emerita), I. Jacob Weinberg, Yong Q. Yin

Associate Professors: Ronald I. Brent, James Graham-Eagle, Ann Marie Hurley, Alan Kaplan, Thomas G. Kudzma (Emeritus) Rida M. Mirie, Guntram B. Mueller, Alexander A. Olsen, Stephen A. Pennell, Shelley L. Rasmussen, Ashot Shahinian, Stanley L. Spiegel, Marvin E. Stick, Joyce W. Williams (Emerita)

Assistant Professors: Louis F. Rossi, Richard E. Winslow

Department Location: Olsen Hall, Room 219

Telephone: (978) 934-2410

Long recognized as a fundamental organizing structure of mind and universe, mathematics is a key discipline in the integration of technology and the humanities. The Department of Mathematical Sciences strives to provide students at all levels of instruction from the nontechnical major to future mathematics teachers, scientists and engineers to graduate students engaged in original mathematics research an awareness of the universality of mathematics and to give them the necessary tools to use mathematics at an appropriate level.

The Mathematical Sciences Department offers a major in Mathematics which leads to the Bachelor of Science degree. Mathematics majors can earn a general degree, or specialize in a specific area by selecting an option: Applied Mathematics, Actuarial Science, Computers, Statistics, or Teaching.

The Department offers a minor in Mathematics to students majoring in other fields.

Mathematics Major

The major in Mathematics is designed to provide a sequence of courses which acquaint the student with the important concepts underlying the main branches of mathematics. The Mathematics major is offered under requirements of the College of Arts and Sciences for the Bachelor of Science degree. The Mathematics major curriculum exceeds the minimal recommendations of the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America for college mathematics majors programs.

It provides a valuable background for subsequent graduate study in mathematics, in related disciplines, and in education. It also prepares students for employment in business and industry. Mathematics majors are encouraged to select a field of specialization by the end of the sophomore year. The areas of specialization, or options, are:

- Applied Mathematics
- Statistics
- Computers
- Actuarial Mathematics
- Teaching

A student may also choose no option and would graduate with simply a bachelor of science degree in mathematics. A student who chooses an option is required to select three courses from an approved list for a particular area. A student who does not choose an option must select three courses from approved lists, but these courses may be chosen for breadth rather than depth.

Elementary and Secondary Education Program

For those students interested in teaching, the College of Education offers a graduate degree program designed to prepare elementary and secondary teachers in mathematics. This provides the coursework and the experience required for certification in Massachusetts and in thirty-three other

states. Interested persons may obtain additional information from the College of Education.

Mathematical Modeling in Industry and Government

For those students interested in graduate school or industry, the Department of Mathematical Sciences reaches out to industry and government to bring real world problems into the university. Three to five students work as a team for a full academic year to solve a single open problem contributed from a company or government agency. This team works closely with a faculty advisor and a liaison from the company or agency that is sponsoring the project to solve the problem during the Fall and Spring semesters. The Mathematical Modeling in Industry and Government program is designed to expose students to original research, large-scale problem solving and demands on mathematical research in society. Students who are interested should contact Prof. Rossi, OS 301B, (978) 934-4474.

Honors in Mathematics

Honors in the Major Field

Selected Mathematics students may qualify for honors in the major field. University requirements for major field honors are described elsewhere under the heading "Honors Program". Superior students are given the opportunity to pursue a more intensive program. The formal granting of honors provides recognition of outstanding interest and performance in mathematics. To earn departmental honors, a student must complete a minimum of 12 credits in honors or graduate mathematics courses in addition to the minimum university requirements..

Pi Mu Epsilon

Pi Mu Epsilon is a national honorary mathematics fraternity. Our chapter is Massachusetts Delta. Election to the fraternity is based on overall cumulative grade-point average and a separate cumulative grade-point average for mathematics courses only. Sophomores, juniors, seniors, and graduate students are eligible for election.

Mathematics Achievement Awards

These are given to the top graduating seniors with a major in Mathematics. Ordinarily two students are chosen to receive these awards.

Mathematics Minor

The Mathematical Sciences Department offers minors for students not majoring in Mathematics. A student who successfully completes the coursework gains depth in mathematics beyond the requirements of the student's major department. Completion of the minor allows the student to receive recognition for this accomplishment. In order to earn a minor the student must file with the registrar an academic petition approved by the Mathematical Sciences Department. This should be done immediately after registration for the courses that will complete the minor.

Minor in Mathematics

A minor in Mathematics consists of 18-24 credits chosen from the mathematics major core and option lists. At least nine of these credits must be in mathematics courses which are not required by the student's major department. A minimum of six credits must be in courses on or above the 300 course level. Linear Algebra II may be substituted for one of the 300 level courses. Prof. Pennell, OS 301, coordinates this program.

Five year B.S./M.S. Program in Mathematics

General description: The five year B.S./M.S. program consists of 120 hours of undergraduate credit and 30-33 hours of graduate credit depending on the graduate option. The 120 hours of undergraduate credit must satisfy all the requirements for an undergraduate degree in mathematics, and the 30 hours of graduate credit must satisfy all the requirements for a Master of Science degree in the chosen option. The options are Applied Mathematics, Scientific Computing, Statistics and Operations Research, and Teacher.

One advantage of the program is that it makes it easier to finish both the B.S. degree and the M.S. in a total of five years. A second advantage is that spreading the

30 hours of graduate credit over a three-year period provides a wider selection of graduate courses. Not all graduate courses are offered on a yearly basis.

Eligibility: Any student who has completed three semesters of the undergraduate mathematics program with a grade point average, overall and in mathematics, of 3.000 or better is eligible for the program. Advanced placement students may apply earlier. An interested student should schedule an appointment with the program coordinator. Following this conference, a student who decides to apply for admission to the program must send a letter of application to the graduate coordinator in the Department of Mathematical Sciences. A committee of the graduate faculty will review the student's record and rule on the application.

With the approval of the Department Graduate Selection Committee the student will file a formal application to the Graduate School during the second semester of the junior year. The student need not have taken the Graduate Record Examination. The committee decision will be based on: a) overall grade point average, b) grade point average in selected subjects, c) recommendations by department faculty, and d) a one year minimum residency at UMass Lowell. Upon approval and recommendation by the Dean of the Graduate School the student may officially become a provisional graduate student in the second semester of the senior year.

Program Planning: The expectation is that the student will begin electing graduate courses during the junior year. The Graduate School catalogue has a complete description of the requirements and options for the M.S. degree. Two approved 400-level courses (six credit hours) may be counted toward the 30 hours of graduate credit required, but these courses may not be included in those used for the undergraduate degree.

Degree Requirements

I. University General Education Requirements (24 credits)

Note: For Mathematics Majors, the General Education requirements include eight elective courses in the areas of:

College Writing	6 cr
Arts & Humanities	9cr
Social Sciences	9 cr

Specific courses that satisfy these requirements are updated periodically. Other General Education requirements in Mathematics and Science & Technology are satisfied by required courses listed below.

II. Major Field Requirements

A. Mathematics

57cr

1. Required Courses

45 cr

Calculus sequence

Calculus I, II, and III or

Calculus IA, IB, II, and III or

AP Credit, Honors Calculus II and III 12 cr

92.221 Linear Algebra I 3 cr

92.222 Linear Algebra II 3 cr

92.234 Differential Equations 3 cr

91.101 Computing I 3 cr

92.301 Intro to Applied Math I 3 cr

92.305 Intro to Real Analysis I 3 cr

92.307 Prob & Math Statistics I 3 cr

92.308 Prob & Math Statistics II 3 cr

92.321 Discrete Structures I 3 cr

92.411 Complex Variables I 3 cr

92.421 Abstract Algebra I 3 cr

92.475 Senior Seminar 3 cr

or 92.457/458 Modeling
in Ind. & Gov. 6 cr

Note: Only four credits from Calculus IA/IB may be applied to a mathematics degree.

2. Option Requirements & Electives 12 cr

Option Requirements

a. Actuarial Mathematics

Three courses including at least one at the 400 level.

92.362 Numerical Analysis I

92.381 Operations Research I

92.382 Operations research II

92.409 Demography

92.416 Theory of Interest

92.417 Actuarial Mathematics

92.452 Statistical Theory

92.483 Applied Statistical Methods

92.591 Stat Modeling & Data Analysis

b. Applied Mathematics

92.362 Numerical Analysis I

Plus one course chosen from the following list:

92.442 Boundary Value Problems

92.443 Theory of Ordinary Differential Equations

92.450 Math Modeling

92.454 Numerical Analysis II

92.483 Applied Statistical Methods

92.584 Stochastic Processes

92.505 Discrete Mathematics

92.567 Numerical Methods for ODE's

Plus any 500-level courses approved for the applied mathematics option of the M.S. program, except 92.563 or 92.564.

c. Computer

92.360 Intro to Data Structures

92.455 Assembly Lang Programming I

Plus one course chosen from:

92.362 Numerical Analysis I

92.560 Data Structures

92.563 Numerical Analysis

92.564 Numerical Algebra

92.583 Cryptography

92.586 Coding Theory

92.591 Stat Modeling & Data Analysis

Plus any 500-level courses approved for the scientific computing option for the M.S. degree.

d. Statistics

92.452 Mathematical Statistics

Plus two courses chosen from:

92.362 Numerical Analysis

92.450 Math Modeling I

92.483 Applied Statistical Methods

92.584 Stochastic Processes

92.489 Topics in Statistics

92.505 Intro to Discrete Mathematics

- 92.582 Time Series Analysis
 92.591 Stat Modeling & Data Analysis
 92.592 Multivariate Statistical Model
 92.593 Experimental Design

Plus any 500 level courses approved for the statistics option for the M.S. degree.

e. Teaching

Three courses chosen from:

92.410 or 92.510 Computers & Calculators in Classroom

92.413 or 92.513 Number Theory

92.420 or 92.520 Mathematical Problem Solving

92.427 or 92.527 Geometry

92.435 or 92.535 History of Mathematical Sciences

f. General (no option)

Three courses selected from the previous option lists including at least one course at the 400 level or above.

Certain courses which are offered infrequently may satisfy option requirements. A list of such courses will be available each semester in the departmental offices.

Elective: In addition to the above, one mathematics course which may be any mathematics course except: 100 level courses, 92.203, 92.207, 92.208, 92.209, 92.216, 92.271, 92.283, 92.302, 92.311, 92.317, 92.385, and 92.386

B. Supporting Sciences 16 cr

Sixteen credits in approved laboratory science courses distributed to conform to the College requirement are required. At least one year of physics is strongly recommended.

Approved Sequences

Biological Sciences: 81.111, 81.112, 81.113, 81.114

Chemistry: 84.121, 84.122, 84.123, 84.124

Geology: 89.121 and 89.123 plus 89.316 and 89.318, or 89.251 and 89.253, or 89.208 and 89.210, or 89.203 and 89.205, or 89.232 and 89.234

Life Sciences: 83.101, 83.102, 83.103, 81.104

Physics: 95.141, 95.144, 96.141, 96.144; or

95.201, 95.202, 96.103, 96.104

Radiological Sciences: 98.401, 98.402, 98.403

Other sequences may be approved, but no more than eight credits in life science may be applied to this requirement.

C. Technical Writing Requirement 3 cr

42.225 Tech and Sci Writing* or

42.306 Professional Writing

* normally offered only through Continuing Education

D. Computing 3 cr

91.101 Computing I or equivalent

E. Minors and Electives 14-17 cr

1. A minor may be elected in another department. Among the minors that are available in the College of Arts & Sciences: Biological Sciences, Chemistry, Economics, Geology, Physics, and Radiological Health Physics.

2. The courses making up the electives and/or minor:

a. must bear a course number prefix other than 90 or 92;

b. may be from the same departments as courses satisfying the core requirements;

c. must not overlap or duplicate mathematics courses. Examples of such courses are: 16.228, 16.315, 16.420; 64.211, 64.212, 66.204; 80.161, 80.162, 80.227, 80.398, and 80.499.

Note: Courses making up a minor may not be used to satisfy the University core requirement.

III. Minimum 120 Credit Requirement

Sample Course of Study

For students entering in Fall 1999 and subsequently

Freshman Year

Fall Semester

92.131 Calculus I* 4

91.101 Computing I 3
 95.141 Physics I 4
 96.141 Physics I Lab 1
 42.101 College Writing I (Gen Ed) 3
 15

Spring Semester

92.132 Calculus II 4
 92.321 Discrete Structures I 3
 95.144 Physics II 3
 96.144 Physics II Lab 1
 42.102 College Writing II (Gen Ed) 3
 14

Sophomore Year

Fall Semester

92.231 Calculus III 4
 92.221 Linear Algebra I 3
 Supporting Science 3
 Supporting Science Lab 1
 42.225 Tech & Scientific Writing or
 42.306 Professional Writing 3
 General Education Req** 3
 17

Spring Semester

92.234 Differential Equations 3
 92.222 Linear Algebra II 3
 Supporting Science 3
 Supporting Science Lab 1
 General Education Req** 3
 General Education Req** 3
 16

Junior Year

Fall Semester

92.301 Applied Math I 3
 92.307 Probability & Statistics I 3
 92. Math Option (400 or above) 3
 General Education Req** 3
 Non-math Elective 3
 15

Spring Semester

92.305	Real Analysis I	3
92.308	Probability & Statistics II	3
92.	Math Option (300 or above)	3
	General Education Req**	3
	General Education Req**	3
		15

Senior Year**Fall Semester**

92.411	Complex Variables I	3
92.421	Abstract Algebra I	3
92.475	Senior Seminar I	3
	General Education Req**	3
	Non-math Elective	3
		15

Spring Semester

92.	Math Option (400 or above)	3
92	Math Elective	3
	Non-math Elective	3
	Non-math Elective	3
	Non-math Elective	3
		15

*Alternative sequence: Calc IA 92.127, Calc IB 92.128, Calc II 92.132, Calc III 92.231; or Precalc 92.121,

Calc I 92.131, Calc II 92.132, Calc III 92.231.

**Note: General Education requirements depend on the year a student enters. See your advisor

**Mathematics Courses
(Prefix: 92)****92.110 College Algebra**

Reviews algebra with the goal of enhancing the student's understanding of basic mathematics. Lays the groundwork for further courses such as Mathematical Perspectives and Introduction to Statistics. I(2,2)3 This course does not satisfy the university General Education requirement in Mathematics.

92.111 Mathematical Perspectives

An introduction to the nature of mathe-

matics, providing insights into what mathematics is, what it accomplishes, and how it is pursued as a human enterprise.

Stresses concepts and relevance to modern experience with topics drawn from areas such as inductive and deductive reasoning, number systems, algebra, geometry, probability, and statistics. Prerequisite: Two years of high school algebra. No credit toward a degree in science or engineering. II(2,2)3

92.115 College Trigonometry

Angles and their measure, the trigonometric functions, solving triangles, law of sines, law of cosines, circular functions and their graphs, and trigonometric identities. No credit toward a degree in science or engineering. Prerequisite: 92.121 or equivalent. II(3,0)3

92.121 Management Precalculus

Review of algebra: operations on the real numbers, exponential notation, factoring, radical notation, and rational exponents. Linear and fractional equations, inequalities, radical equations, and quadratic equations. Relations, functions, graphs, symmetry, straight lines, circles, parabolas, systems of equations, and mathematical models. No credit toward a degree in science or engineering. I,II(2,2)3

92.122 Management Calculus

Differential calculus: limits, continuity, derivatives, differentials, higher-order derivatives, implicit differentiation, maxima and minima of functions, and applications of derivatives to business and economics. Integrals & Applications to business. Prerequisite: 92.121. Primarily for students in Management. No credit toward degree in science or engineering. II(2,2)3

92.124 Precalculus for Science and Engineering

Reviews some high-school mathematics for prospective calculus students. The following topics are included: fractions, exponents and radicals; relations, functions, and graphs; exponential and logarithmic functions; trigonometry and the trigonometric functions; imaginary and complex numbers; polynomials and rational functions; the conic sections. A graphics calculator is required for this course. No credit toward a degree in science or engineering. II(3,0)3

92.127 Calculus IA

A review of precalculus algebra and trigonometry integrated with the first half

of Calculus I. Functions, limits, continuity, the derivative, the chain rule, related rate problems. For technical degree programs, including Mathematics, only two credits of this course may be applied toward a degree. I,II(4,0)4

92.128 Calculus IB

A review of precalculus algebra and trigonometry integrated with the second half of Calculus I. Implicit differentiation, max/min problems, and curve sketching. Integrals and areas. For technical degree programs, including Mathematics, only two credits of this course may be applied toward a degree. For prerequisites, completion of this course is equivalent to 92.131. Prerequisite: 92.127. I,II(4,0)4

92.131 Calculus I

A first calculus course. Functions, limits, continuity, derivatives, rules for differentiating algebraic and transcendental function; chain rule, implicit differentiation, related rate problems, max/min problems, curve sketching; integrals and areas. I,II(4,0)4

92.132 Calculus II

A continuation of Calculus I. Volume, arc length, surface area, pressure and force. Differentiation and integration of trigonometric, inverse trigonometric, exponential, logarithmic, and hyperbolic functions. Improper integration, infinite series, Taylor and MacLauren series. Prerequisite: 92.131. I,II(4,0)4

92.141 Honors Calculus I

This course covers the same topics as 92.131 Calculus I, but in an enriched environment.

92.142 Honors Calculus II

This course covers the same topics as 92.132 Calculus II, but in an enriched environment.

92.183 Intro to Statistics

Sets and probability laws, random variables, mathematical expectations, measure of central tendency and variance. Study of discrete and continuous probability distribution, sampling theory, tests of hypothesis. Regression and correlation. May not be taken for credit along with 92.283, 92.385 or 92.386. May not be used to satisfy Mathematics major requirements. I,II(3,0)3

92.216 History of Mathematics

An investigation of creative mathematics through the lives of mathematicians from

classical times to the present. I(3,0)3

92.221 Linear Algebra I

Elementary set theory and solution sets of systems of linear equations. An introduction to proofs and the axiomatic methods through a study of the vector space axioms. Linear analytic geometry. Linear dependence and independence, subspaces, basis. Inner products. Matrix algebra. I(3,0)3

92.222 Linear Algebra II

Linear transformations. Linear operators, change of basis, and the diagonalization problem. Quadratic forms. Convex sets and geometric programming, input/output models for an economy, Markov chains, other applications of linear algebra. Prerequisites: 92.221 and 92.132. II(3,0)3

92.231 Calculus III

A continuation of Calculus II. Polar Coordinates, parametric equations, vectors and analytic geometry in space. Functions of several variables, partial derivatives, and chain rule. Tangent planes and normal lines. Maxima and minima, Lagrange multipliers, and multiple integrals. Prerequisite: 92.132. I,II(4,0)4

92.234 Differential Equations

Classification and solution of ordinary differential equations of the first order and higher orders. The Laplace transform. Applications. Prerequisite: 92.132. I,II(3,0)3

92.236 Engineering Differential Equations

Introduction to differential equations with an emphasis on engineering applications. Topics include first-order equations, higher-order linear equations with constant coefficients, and systems of first-order equations. Applications of each topic are introduced and qualitative, analytical, and numerical solution techniques are studied. Laplace transform methods are discussed. The software package MATLAB is used throughout the course. Prerequisite: 92.132

92.241 Honors Calculus III

Covers the same topics as 92.231 Calculus II, but in an enriched environment.

92.267 C Programming

Introduces students to the techniques of programming in C. The language syntax, semantics, its applications and the

portable library are covered. Prerequisite: 92.265 (3,0)3

92.271 Differential Equations for Chemical Equations

Ordinary differential equations with intensive coverage of Laplace Transforms, including step and control functions. Series solutions, including methods of Taylor, Frobenius, and Bessel. Methods of solution of partial differential equations and boundary value problems. Vector calculus. Numerical analysis including Newton's and Runge-Kutta Methods, error analysis, and finding polynomials from difference tables. May not be taken for credit with 92.234. Prerequisite: 92.231 or equivalent. Not open to Mathematics majors. I,II(4,0)4

92.283 Statistics for the Behavioral Sciences

An introduction to basic statistics as used in the behavioral sciences including descriptive statistics, sampling, the normal distribution, correlation and regression, and inferential statistics, including t-tests, F-tests, Chi-square tests and analysis of variance. The course also includes computer methods for solution of problems. May not be taken for credit along with 92.183 or 92.386. Prerequisite: 92.111 or equivalent. I,II(3,0)3

92.301 Intro to Applied Mathematics I

Vector analysis, Green's Theorem, Divergence Theorem, Stokes' Theorem. Fourier series and integrals. Partial differential equations of physics and engineering. Prerequisite: 92.231 and 92.234. I(3,0)3

92.302 Intro to Applied Mathematics II

Matrix algebra, solution of systems of linear equations, eigenvalues and eigenvectors, solution of differential equations by matrix methods. Series solution of differential equations. Bessel and Legendre functions. Sturm-Liouville problems. Prerequisites: 92.231 and 92.234. II(3,0)3

92.305 Intro to Real Analysis I

Real and complex number systems. Sequences and series of complex numbers. Theory of metric spaces: completeness, compactness, continuity, uniform continuity. Differentiability of functions. Taylor's theorem. Prerequisites: 92.221 and 92.231. II(3,0)3

92.306 Intro to Real Analysis II

Sequences and series of functions. Uniform convergence. Elementary functions. Functions between Euclidean spaces: the derivative as a linear map, the Jacobian, inverse function theorem, implicit function theorem, Taylor's theorem. Integration of real valued functions on Euclidean space, fundamental theorem of the integral calculus, change of variables formula. Prerequisite: 92.305. (3,0)3

92.307 Probability and Mathematical Statistics I

Probability, random variables, discrete and continuous densities, expectation and variance, special distributions (binomial, Poisson, normal, gamma, etc.), moment generating functions, joint and conditional distributions, transformations of variables, sampling, central limit theorem. Prerequisite: 92.231. I(3,0)3

92.308 Probability and Mathematical Statistics II

Point estimation and confidence intervals, hypothesis testing, correlation, linear regression, analysis of variance for the one- and two-way design, nonparametric methods, chi-square tests for contingency tables. Prerequisite: 92.307. II(3,0)3

92.321 Discrete Structures I

Propositional logic, combinatorics, proof methods, mathematical systems; algebraic sets, matrix algebra, relations, functions; recursion and generating functions. Applications to Computer Science. I(3,0)3

92.322 Discrete Structures II

Graph theory, trees, algebraic systems. Boolean algebra, groups, monoids, automata, finite-state machines, rings, fields. Applications to coding theory, sorting, logic design. Prerequisite: 92.321. II(3,0)3

92.360 Intro to Data Structures

Basic concepts of data. Linear lists, strings, arrays, and orthogonal lists. Trees and graphs. Storage systems and structures. Storage allocation and collection. Multilinked structures. Symbol tables, searching and sorting (ordering) techniques. Prerequisites: 92.221 or 321 and 92.265 or 92. 267. II(3,0)3

92.362 Numerical Analysis I

Theory and application of numerical techniques including error analysis. Solution of linear, nonlinear, and differential equa-

tions. Interpolation, numerical integration, and curve fitting. Computer solutions are emphasized. Prerequisite: 92.231/136, 92.234 and knowledge of one computer language. I,II(3,0)3

92.363 Intro to Data Analysis

Computer analysis of data derived from research conducted in physical, social, and life sciences. Data preparation. Data modification, file manipulation, and descriptive statistics using SPSS. Programming ability is not required. Prerequisite: 92.183 or equivalent. Also senior or junior status or permission of Chairperson. I,II(3,0)3

92.381 Intro to Operations Research Techniques I

The use of decision models in industrial systems. Fundamentals of probability and matrix theory. Critical path methods. Linear programming. The simplex method. Sensitivity analysis. Goal programming. Transportation and assignment models. Integer programming. Prerequisite: 92.131/135 or 92.201. I(3,0)3

92.382 Intro to Operations Research Techniques II

A continuation of 92.381. Topics include: inventory control models, Markov analysis, queuing models, dynamic programming, network analysis, and simulation techniques. Prerequisite: 92.381. II(3,0)3

92.386 Statistics for Engineering and Science

A one semester course in probability and statistics with applications in the engineering sciences. Probability of events, discrete and continuous random variables, density functions, distributions. Estimation, hypothesis testing, regression and correlation. May not be taken for credit along with 92.183, 92.283 or 92.385. May not be used to satisfy Mathematics major requirements. Prerequisite: 92.132. II(3,0)3

92.409 Demography

The study, the methods, and the materials used in the systematic compilation and analysis of population data. Primary focus is on learning sources of data, definitions, collection techniques, population characteristics and dynamics, summarizing and analyzing data, and methods of estimating and projecting local populations. Prerequisite: 92.183 or equivalent. I(3,0)3

92.410 Computers and Calculators in the Classroom

This course explores the roles of mainframes, PC's and hand calculators in instruction, examine some of the available software and consider their use in a variety of areas of secondary mathematics, such as algebra, geometry (Euclidean and analytic), probability and statistics and introductory calculus. (3,0)3

92.411 Complex Variables I

Complex numbers. Functions of a complex variable, mappings, derivatives, analytic functions. Elementary functions. Laurent series, residues and poles, contour integration. Prerequisites: 92.231. I(3,0)3

92.412 Complex Variables II

Transformations. Conformal mappings. Boundary conditions. Applications in heat conduction, electrostatic potential, and fluid flow. Gamma and beta functions. Inverse Laplace transform. Riemann surfaces. Prerequisite: 92.411.

92.413 Number Theory

Congruences and Chinese Remainder Theorem, Primitive roots, quadratic reciprocity, approximation properties of continued fractions, Pell's equation. Recent applications of number theory such as primarily testing, cryptology, and random number generation. Prerequisite: 92.221 or 92.321. I(3,0)3

92.416 Compound Interest and Annuities-Certain

Basic concepts and definitions of various types of annuities, valuation of annuities-certain, valuation of securities and sinking funds, determination of yields, and construction of tables. Prerequisite: 92.231. I(3,0)3

92.419 Computer Algebra with Mathematica

A project-based course starting with an introduction to the basic features of Mathematica. A project that allows the student to focus on certain features in more detail is required and occupies the second half of the course. (3,0)3.

92.420 Mathematical Problem Solving Focus tract Algebra II

Focuses on: mathematical resources, ability to use heuristics, the student's beliefs about the use of mathematics to solve problems, and the student's self confi-

dence as a problem solver. Effective strategies for incorporating problem solving in the curriculum is also discussed. Prerequisite: 92.221 or 92.321. (3,0)3

92.421 Abstract Algebra I

Elementary group theory, groups, cosets, normal subgroups, quotient groups, isomorphisms, homomorphisms, applications. Prerequisite: 92.221 or 92.321. I(3,0)3

92.422 Abstract Algebra II

Elementary ring and field theory, quotient rings and ideals, homomorphisms of rings, rings of polynomials, algebraic extensions, automorphisms of field, separable extensions. Galois Theory. Prerequisite: 92.421. II(3,0)3

92.427 Geometry

A wide survey of topics related to secondary school geometry; axiomatic systems and Euclidean geometry; constructions in geometry; analytic geometry; introduction to Noneuclidean geometry. Prerequisite: 92.221 or 92.321

92.428 Computational Geometry

Processing of geometric data to identify properties and structures. Fundamental geometric prerequisites, convex hulls, Voronoi diagrams. I(3,0)3

92.431 Topology

Provides an introduction to the important concepts of point-set topology and a brief taste of algebraic topology. Included among the topics covered are: metric spaces and topological spaces; continuity, connectedness, and compactness; and the fundamental group. Prerequisite: 92.306. I(3,0)3

92.435 History of Mathematica Science

An ancient numeral systems, Babylonian and Egyptian mathematics, Pythagorean mathematics, duplication, trisection, and quadrature, Euclid's Elements and Greek mathematics after Euclid. Hindu and Arabian mathematics, European mathematics from 500 to 1600. Origins of modern mathematics, analytic geometry, history of calculus. Transition to the twentieth century, contemporary perspectives. Prerequisite: 92.231. I(3,0)3

92.442 Boundary Value Problems

Partial differential equations of physics and engineering. Boundary value problems, Fourier series, convergence tests. Sturm-Liouville problems. Orthogonal sys-

tems and generalized Fourier series. Fourier integrals and applications. Prerequisite: 92.306 or permission of instructor. I(3,0)3

92.443 Theory of Ordinary Differential Equations

Differential equations in Euclidean space. Existence, uniqueness, and continuation of solutions. Autonomous systems and the Poincaré-Bendixson theory. Linear and perturbed linear systems. Plane systems, the neighborhood of critical points and closed orbits. Liapunov stability. Periodic systems and Floquet theory. Prerequisite: 92.305. I(3,0)3

92.450 Mathematical Modeling

Devoted to studying the application of mathematics in government and industry. It includes numerous case studies which employ the techniques of graphical, optimization, and dynamic modeling. Prerequisite: senior Math major or permission of instructor. II(3,0)3

92.452 Intermediate Mathematical Statistics

A survey of topics in mathematical statistics including those covered in the second actuarial exam. Maximum likelihood estimation, sufficient statistics, completeness and uniqueness, likelihood ratio tests, UMP tests, Rao-Blackwell theorem, non-central chi-squared and F distribution, SPRT, some multivariate distributions. Prerequisite: 92.307. II(3,0)3

92.454 Numerical Analysis II

Continuation of 92.362 including: numerical solution of ordinary and partial differential equations, boundary value problems, curve-fitting, error analysis, and computer solutions. Prerequisite: 92.362 and 92.234. II(3,0)3

92.457/458 Modeling in Industry and Government I,II

For those students interested in graduate school or industry. Three to five students work as a team for a full academic year to solve a single open problem contributed from a company or government agency. Designed to expose students to original research, large-scale problem solving and demands on mathematical research in society.

92.475 Senior Seminar I

Undergraduate seminar on advanced mathematical topics. Students are

required to develop an understanding of an advanced subject beyond the scope of an existing course or synthesize two or more different areas from their curriculum. Students are required to participate in the seminar, present their results to the Department and write a substantial thesis in their topic area. Essential course elements include library research, original research, and both verbal and written exposition. The first semester is a graduation requirement for undergraduates entering after Spring 1999, unless students enroll in the 92.475/458 sequence. The second semester is optional. Seniors only. I(3,0)3

92.476 Senior Seminar II

An optional second semester seminar to allow for continuation of study initiated in Senior Seminar I. Prerequisite: 92.475 II(3,0)3

92.481 Operations Research I

General linear programming problem, simplex method, duality and sensitivity analysis, transportation and network problems, dynamic programming, integer (linear) programming, PERT. Prerequisite: 92.221. I(3,0)3

92.482 Operations Research II

Probability review (moment generating functions and Z-transforms). Inventory models, queuing theory, Markov chains, and decision models. Nonlinear programming. Prerequisite: 92.481. II(3,0)3

92.483 Applied Statistical Methods

The development of statistical techniques without the use of calculus. Analysis of variance, multiple and curvilinear regression, and nonparametric methods. Prerequisite: 92.386 or equivalent. I(3,0)3

92.489 Topics in Statistics

Topics from the literature of statistics. May be repeated an indefinite number of times, but particular topics must differ. Prerequisite: permission of instructor. I(3,0)3

Directed Studies

Directed studies courses are available only to Mathematics majors and may be elected provided that 1) material to be covered is not available in any other mathematics course, 2) instructors are willing to undertake a directed studies, and 3) no more than nine credits in mathematics are taken

in directed studies courses.

92.490 Directed Studies in Computer Mathematics

Individual study for the student desiring more advanced or more specialized work relating to the computer. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.491 Directed Studies in Analysis

Individual study for the student desiring more advanced or more specialized work in analysis. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.492 Directed Studies in Algebra

Individual study for the student desiring more advanced or more specialized work in algebra. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.493 Directed Studies in Geometry

Individual study for the student desiring more advanced or more specialized work in geometry. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

Graduate Level Courses

500 level courses are primarily for graduate students, but all graduate courses are open to qualified undergraduate students with permission of the instructor.

92.500 Discrete Structures

An introduction to discrete mathematics, including combinatorics and graph theory. The necessary background tools in set theory, logic, recursion, relations, and functions are also included. Masters degree credit for Teacher Option Only. (3,0)3

92.501 Real Analysis I

Real and complex number systems; sequences and series; topology of the real line: completeness, compactness, continuity; differentiability of single variable functions; and sequences and series including uniform convergence. (3,0)3

92.502 Real Analysis II

Topology of metric spaces, multivariable functions, derivative as linear maps, Jacobians, inverse and implicit function theorem, Taylor's theorem, and introduction to measure theory. (3,0)3

92.503 Mathematical Analysis

Metric spaces: completeness, compactness, connectedness; and continuity, discontinuities, uniform convergence, power series, differentiation, and integration. Masters degree credit for Teacher Option Only. (3,0)3

92.505 Discrete Mathematics

Basic counting rules, permutations and combinations, recurrence relations. Asymptotic algorithms analysis, NP-completeness, heuristic algorithms. Linear, integer, and dynamic programming. Coding Theory. Applications. Prerequisite: Linear Algebra or Discrete Structures. (3,0)3

92.507/508 Applied Functional Analysis I, II

Vector, metric, normed, Banach and Hilbert spaces. Spectral theory of linear, compact, and unbounded linear operators. Integral and differential equations, approximation theory, and quantum mechanics. I(3,0)3, II(3,0)3

92.510 Computers and Calculators in the Classroom

Explores the roles of mainframes, PCs and hand calculators in instruction, examine some of the available software, and consider their use in a variety of areas of secondary mathematics, such as algebra, geometry (Euclidean and analytic) probability and statistics, and introductory calculus. Masters degree credit for Teacher Option Only. (3,0)3

92.511 Complex Variables I

Complex numbers, elementary functions and their geometric representation. Power series. Singularities. Entire and meromorphic functions. Periodic functions. (3,0)3

92.512 Complex Variables II

Differentiation and integration of complex analytic functions. Cauchy's integral theorem and formula. Singularities and Laurent series. Theory of residues and applications. Harmonic functions. Conformal mapping. Prerequisite: 92.501. (3,0)3

92.513 Number Theory

Study of primes, congruences, number-theoretic functions, Diophantine approximation, quadratic forms and quadratic number fields. Additional topics as time permits. (3,0)3

92.516 Pattern Recognition

Random vectors: transformations of random vectors. Hypothesis Testing: error probability, sequential tests; supervised learning; Nearest Neighbor and Parzen Kernel Approach and feature extraction. Prerequisites: calculus, probability, matrix algebra. (3,0)3

92.520 Mathematical Problem Solving

Mathematical resources; heuristics; control of resources and heuristics; and belief systems. Strategies for incorporating problem solving into the curriculum. Masters degree credit for Teachers Option Only. (3,0)3

92.521 Algebraic Structures I

Properties of rings, groups, fields, polynomials over fields, extension rings and fields, vector spaces, codes, and additional applications. (3,0)3

92.523 Linear Algebra I

Sets and maps; vector spaces and linear maps, matrix of linear maps, solving systems of equations, scalar products and orthogonality, eigenvalues and applications. Masters degree credit for Teachers Option Only. (3,0)3

92.527 Geometry

A wide survey of topics related to secondary school geometry; axiomatic systems and Euclidean geometry; constructions in geometry; analytic geometry; introduction to Noneuclidean geometry. Prerequisite: 92.221 or 92.321

92.529 Differential Geometry

Differential geometry involving curves and surfaces in 3-space. Curvature, torsion, Frenet equations, intrinsic equations, involutes and evolutes. (3,0)3

92.530 Applied Mathematics I

Matrices, vector analysis, divergence, Green's and Stokes' theorem, series solution of differential equations, boundary value problems. Fourier series and integrals. Partial differential equations, separation of variables. I(3,0)3

92.531 Applied Mathematics II

A continuation of 92.530. II(3,0)3

92.535 History of Mathematical Science

Ancient numeral systems, Babylonian and Egyptian Mathematics, Pythagorean mathematics, duplication, trisection and quadrature, Euclid's Elements and Greek mathematics after Euclid, Hindu and Arabian mathematics, European mathematics from 500 to 1600, origins of modern mathematics, analytic geometry, history of calculus, transition to the 20th Century, contemporary perspectives. Masters degree credit for Teachers Option Only. (3,0)3

92.539 Differential Forms & Their Applications I

Vector calculus; curves and surfaces; differential forms and multilinear maps. (3,0)3

92.540 Differential Forms & Their Applications II

The gradient, curl, and divergence as exterior derivatives; the general Stokes' Theorem; applications to electrodynamics and thermodynamics. (3,0)3

92.541,542 Fourier Analysis & Boundary Value Problems I,II

Fourier series and integrals. Orthogonal systems and Sturm-Liouville problems. Applications to boundary value problems in rectangular, cylindrical, and spherical coordinates. Distributions and their applications. Prerequisite: 92.501 (3,0)3

92.543 Ordinary Differential Equations

Existence, uniqueness, and smoothness of solutions. The Poincaré-Bendixson theory. The neighborhoods of critical points and closed orbits. Liapunov stability. Linear and perturbed linear systems. Prerequisite: 92.501. (3,0)3

92.545 Partial Differential Equations I

Introduction to partial differential equations in the plane and space with engineering applications. Solution of initial and boundary value problems. Complex variables and transform theory. (3,0)3

92.546 Partial Differential Equations II

A continuation of 92.545. (3,0)3

92.547 Integral Equations

Exact, iterative, and numerical techniques for the solution of linear Volterra and

Fredholm integral equations, theorems for general operators. Symmetric kernels, orthogonal system of functions, and the Hilbert-Schmidt theorem. Applications. (3,0)3

92.548 Math of Signal Processing I
Representation of signals: Fourier analysis, fast Fourier transforms, orthogonal expansions. Transformation of signals: linear filters, modulation; band-limited signals; sampling; uncertainty principle; Windows and extrapolation. Prerequisite: 92.501. (3,0)3

92.550 Mathematical Modeling
Devoted to studying the application of mathematics to real-life problems from the physical, biological, social, and behavioral sciences. Provides experience in a wide variety of models (deterministic, stochastic, simulation, continuous, discrete, axiomatic). Encourages computer use in problem solving. Prerequisite: 92.234. Masters degree credit for Teacher Option Only. (3,0)3

92.551 Calculus of Variations
The first variational problem, necessary conditions. Euler's equation. Generalization to dependent and independent variables. Constraints and Lagrange multipliers. Application to dynamics and elasticity. Direct methods. Prerequisite: 92.501. (3,0)3

92.552 Wavelet Analysis
Introduction to time-frequency localization of signals; frames; windowed Fourier transforms; continuous and discrete wavelet transforms; time frequency sampling theorems; orthonormal bases of wavelets; algebraic wavelet theory; applications to electrodynamics and optics. Prerequisite: A working knowledge of Fourier series and integrals and some familiarity with orthogonal expansions of functions. Consult the instructor. II(3,0)3

92.560 Data Structures & Algorithms I
Implementations of lists, stacks, queues, ordered and binary trees, and priority queues. Tree traversals. Open and closed hashing. Directed graphs: shortest paths and acyclicity. Prerequisite: Discrete Structures and Introduction to Data Structures. (3,0)3

92.563 Numerical Analysis
Nonlinear equations in one and several variables. Numerical differentiation and integration. Numerical methods for ordi-

nary differential equations and for the Laplace, heat, and wave equations. Prerequisite: 92.501. (3,0)3

92.564 Numerical Algebra
Solution of linear systems. Eigenvalue, eigenvector problem. Fast Fourier Transform. Introduction to finite elements. Least squares. Splines, Chebyshev approximation. (3,0)3

92.570 Probability and Statistics
Overview of descriptive statistics, data analysis, probability of events, discrete random variables, continuous random variables, normal, binomial and other probability distributions, central limit theorem, survey sampling, estimation, hypothesis testing, regression, experimental design, analysis of categorical data, nonparametric statistics. Masters degree credit for Teachers Option Only. (3,0)3

92.571 Linear Optimization
Simplex and revised simplex methods, duality, sensitivity analysis, the transportation problem and other applications, degeneracy procedures, computational techniques. Introduction to integer programming. (3,0)3

92.572 Nonlinear Optimization
Unconstrained optimization, Lagrange multipliers, Kuhn-Tucker theory, quadratic programming, convex programming, numerical methods. (3,0)3

92.575 Data Structures & Algorithms II

Divide and conquer, radix and comparison sorts, order statistics, union-find, balanced trees, graph connectivity, path finding, matrix multiplication, Fast Fourier transform, pattern matching, NP-completeness. Prerequisite: 92.560. (3,0)3

92.579 Reliability Life Data Analysis
Introduces statistical methods for analyzing data obtained from lifetime testing of products. Statistical failure models, testing reliability hypotheses and accelerated life testing. Prerequisites: Probability or Statistics for Engineering and Science. (3,0)3

92.580 Combinatorics
Generating functions, recurrence relations, inclusion-exclusion, Polya theory. Experimental designs (block design). Partially ordered sets. Applications. Prerequisites: Calculus and Discrete Structures. (3,0)3

92.581 Graph Theory
Terminology, theorems, algorithms, and applications of graph theory. Trees, circuits, and connectivity. Hamiltonian and Eulerian graphs. Shortest routes, matching, network flows. Covering, coloring, Ramsey theory. Prerequisite: Linear Algebra or Discrete Structures. (3,0)3

92.582 Time Series Analysis
Building models for discrete time series and dynamic systems and their use in forecasting and control. Stationary and non-stationary time series models. Box-Jenkins (ARMA) and other techniques. Prerequisite: permission of the instructor. (3,0)3

92.583 Cryptography
Basic concepts; some classical cryptographic examples; modern encryption algorithms, the Data Encryption Standard (DES), public key systems probabilistic encryption; aspects of key management and inference controls in statistical data bases. Prerequisite: permission of instructor. (3,0)3

92.585 Queuing Theory
Single-sever queuing systems, queue length, and waiting time. Multi-sever queuing systems. Modeling of telephone systems, interactive computer systems. Prerequisites: Statistics and Probability. (3,0)3

92.586 Coding Theory
Error correcting and decoding. Applications to data processing, transmission and security. Linear block, cyclic, convolution and arithmetic codes. Applications from communications and computer science. Prerequisite: Discrete Structures. (3,0)3

92.587 Probability and Mathematical Statistics

Algebra of probabilities, random variables, classic distributions. Measure-theoretic axiomatic. Analytical methods. Limit theorems. Statistical methods: sampling, estimation, regression and correlation. Prerequisite: 92.501. (3,0)3

92.588 Mathematical Statistics
Random variables, densities, joint and conditional distributions, expectations, variance, estimation, sufficiency and completeness, hypothesis testing, limiting distributions. (3,0)3, (3,0)3

92.589 Theory and Methods of Sampling from Finite Populations

Simple random sampling, systematic sampling, stratified random sampling, multi-stage cluster sampling, regression estimation, ratio estimation, effect of costs on sample allocation and nonsampling errors. (3,0)3

92.590 Statistical Quality Control

Introduction to statistical methods useful in quality assurance. Description of control charts for attributes and variables, process-capability analysis and acceptance sampling. Prerequisite: Probability or Statistics for Engineering & Science. (3,0)3

92.591 Regression Analysis

Model building via linear regression models. Method of least squares, theory and practice. Checking for adequacy of a model, examination of residuals, checking outliers. Practical hands-on experience in linear model building on real data sets. Prerequisite: Probability, Biostatistics, or Statistics for Engineering and Science. (3,0)3

92.592 Multivariate Statistical Modeling

Nonlinear model building via the method of least squares. Discriminant and factor analysis, principal components, profile analysis, canonical correlation, cluster analysis. Experience on real data sets. (3,0)3

92.593 Experimental Design

How to design, carry out, and analyze experiments. Randomized block designs, randomization, blocking, matching, analysis of variance and covariance, control of extraneous variables. (3,0)3

92.594 Control Theory

Analytical and numerical methods for optimization of deterministic and stochastic dynamic systems. Prerequisite: 92.501. (3,0)3

92.595 Information Theory

Shannon theory including information measure and transmission rates and capacities. Elements of coding theory. Prerequisite: 92.501. (3,0)3

92.596 Finite Elements

Mathematical formulations and techniques including an introduction to variational methods. Examples from solid mechanics,

heat transfer, and fluid mechanics.

Prerequisite: 92.501. (3,0)3

92.599 Approximation Theory

Uniform approximation by polynomials. The Weierstrass and Jackson theorems. Characterization of best approximation. Least squares approximation. Approximation by splines and rational functions. Prerequisite: 92.501. (3,0)3

92.651,652 Directed Studies I, II

Intended to satisfy individual student needs. Topics include various fields of mathematics. Prerequisite: permission of instructor and graduate coordinator. (3,0)3, (3,0)3

92.653,660 Selected Topics I, II

Advanced topics in various fields of mathematics and related fields. Since topical coverage varies from term to term, a student may be allowed to receive credit more than once for this course. Prerequisite: permission of instructor. (3,0)3

Department of Music

Dr. William Moylan, Chairperson

Professors: Ruth Ashley (Emerita), Dean Bouzianis (Emeritus), Donald Bravo (Emeritus), Alma O. Espinosa, Gerald J. Lloyd, David Martins, Christopher McGahan, Anthony Mele, William Moylan, Ingul Ivan Oak, John Ogasapian, Natalo Paella (Emeritus), Kay George Roberts, Rosita Sands, Rawn Spearman (Emeritus), Willis Traphagan (Emeritus), W. Anne Trenkamp, Robert White (Emeritus)

Associate Professor: Jacqueline Charette, Antone Holevas (Emeritus)

Assistant Professors: Peter McCoy, John Shirley, Paula Telesco

Adjunct Faculty: Eunice Alberts, Janice Bennett, Anne Black, Fred Buda, Mark Cantrell, Sandra Carlson-Wood, Alexander Case, Lisa Cleveland, Jeffrey Fischer, Joseph Foley, Janice Giampa, Gary Gottlieb, Richard Greenblatt, Mark Henry, Tad Hitchcock, Keith Jones, James Lattini, Paul Lehrman, Daniel Lutz, William MacMullen, Inge Magid, Ellen Michaud-Martins, Mark Peterson, Marc Phaneuf, Martin Polon, Coleman Rogers, Richard Schilling, John Skelton, Peter Spellman, Thomas Stumpf, David Thibodeau, Juanita Tsu, Susan Turcotte-Gavriel, Jon Wheatly, Alan Williams, Douglas Worthen

Main Office Location: Durgin Hall, Room 104

Telephone: (978) 934-3850

Bachelor of Music Degree

Music majors pursuing the Bachelor of Music degree are preparing for a career in music. The Bachelor of Music degree offers four areas of emphasis: performance, music business, sound recording technology, and music teaching preparation. Programs combining two areas of specialization, e.g., music teaching preparation and performance, are also available. A student desiring to pursue such a combined course of study must satisfy the requirements in both areas and should plan to spend one or more semesters in residence beyond the normal eight semesters of full-time study required for the

successful completion of a program with a single area of specialization.

Individual and group performances are important aspects of all Bachelor of Music programs; students in the performance specialization, however, are required to demonstrate outstanding ability as performers in order to satisfy admission and retention standards. Students preparing for admission to the music teaching preparation specialization are required to select applied music courses (private lessons) each semester for maintaining and developing their music skills, and they are expected to develop minimum standards of performance in piano and in their areas of performance emphasis.

The music teaching preparation specialization is subject to the same rules and regulations as those which govern all teacher education programs of the University.

All Bachelor of Music candidates must participate in one two-credit or two one-credit ensembles during each semester of their residence as full-time students, unless otherwise specified.

General Department Requirements

In order to qualify for a baccalaureate degree offered in the Department of Music, undergraduates must comply with the University general education requirements, must conform to the requirements of the Department of Music which govern degrees and major studies for such degrees, and must earn at least a 2.000 average in their major concentrations of specialization by the end of the senior year. Additional requirements are specified for retention in specific degree programs.

Language Proficiency

Vocal performance majors are required to complete two consecutive semesters of the same foreign language, plus 75.261 Diction for the Singer I (English and German), and 75.262 Diction for the Singer II (Italian and French).

Declaration of Major

Music majors are accepted into their intended majors conditionally. They must officially apply to their program of choice. See specific major for requirements and deadlines.

Transfer Policies

Students transferring to the Department of Music from other colleges of the University or from other institutions may expect recognition for previously completed courses if these are equivalent to those which are specified by curricula of the Department. Students wishing to transfer to Bachelor of Music programs are required to demonstrate their vocal or instrumental ability during an audition before the Faculty of the Department of Music and complete placement testing in music theory.

Applied Music

All Bachelor of Music degree students in the music teaching preparation program must successfully complete eight semesters of applied music (private lessons) on their principal instrument. The performance specialization requires eight semesters of study and a public senior recital. Music Business students and sound recording technology are required to take six semesters of applied music. An evaluation by a faculty panel is required of all full-time undergraduate music students each semester, with the exception of the first semester of the freshman year. Studio grades are submitted to the faculty panel prior to the evaluation. In computing the final grade, the faculty evaluation panel may raise or lower the studio grade by a maximum of one full letter grade, or the panel may allow the student grade to stand as submitted. Any student who fails to perform for the faculty panel because of an unexcused absence will receive a final semester grade of F.

Any student enrolling for applied music beyond the credits required for his or her respective degree and major must do so through the Continuing Studies and Corporate Education.

Panel (Jury) Evaluations

With the exception of first semester freshmen, all undergraduate students play a panel evaluation each semester of residency. In the semester that a required recital is performed, the student is exempted from a panel evaluation.

Recital Attendance Requirement

All undergraduate music majors are required to attend ten concerts and/or recitals each semester from among those listed on the Department of Music

Performance Calendar. In addition, attendance at scheduled recital hours on Thursdays is required.

Seven satisfactory semesters of recital attendance are required of each undergraduate student with the following exceptions: 1) students who are in residence fewer than seven semesters and transfer students must fulfill the recital attendance requirement for each semester of residence as full-time matriculated degree students; and 2) part-time students have no requirement.

Failure to complete the total recital attendance requirement will result in denial of graduation

Ensemble Requirements (Auditions)

All music students must audition for ensemble assignment during the first week of the fall semester. Auditions are held during the first week of the spring semester for all new music students, transfers and re-admitted students. Students who do not qualify for a two-credit ensemble are assigned to two one-credit ensembles. Ensemble assignments are usually for the academic year.

Music students who elect to participate in Marching Band or Jazz Rock Big Band must also audition for assignment to an appropriate choral or instrumental ensemble.

Ensemble Requirements (Participation)

All music students are required to be enrolled, as assigned, in two credits of ensemble for each semester in which they are full-time students.

Vocal majors will be assigned to a choral ensemble. Wind, string, brass and percussion majors will be assigned to an instrumental ensemble. Keyboard (piano and organ) and guitar majors will be assigned to an ensemble that emphasizes their major instrument such as guitar, piano or Mixed Chamber Ensemble and possibly to a choral or instrumental ensemble.

Student Recitals

Students in the performance major are required to present a senior recital, usually while enrolled in Performance Applied 7. Students may petition the Department Chairperson for permission to present the senior recital one semester early during Performance Applied 6. Students in other

specializations may also present public recitals. In all cases, students wishing to present a recital must receive recital permission from the applied music instructor, the appropriate applied music area head and the Chairperson of the Department of Music. A recital permission form may be obtained from the Music office and must be submitted no later than November 15th in the fall semester and March 15th in the spring semester.

Performance Specialization (Bachelor of Music)

Students wishing to pursue the specialization in performance may apply to the Chairperson of the Department and are subject to the following requirements:

Application for Performance Specialization

1. Admission is limited to freshmen, sophomores, juniors or seniors; application is usually made at the end of the first semester;
2. application forms are available in the Department of Music Office and must be submitted to the Department Chairperson no later than December 1 for fall auditions, May 1 for spring auditions, and August 15 for summer auditions; and
3. written recommendations from the applied instructor and the appropriate applied area head must be submitted to the Chairperson of the Department of Music by December 6 for fall and May 6 for spring.

Admission Requirements

1. A minimum grade of B is required for each ensemble and applied course;
2. a grade point average of 2.000 must be achieved in all music courses;
3. a minimum of nine music credits are required and must include credit for the following courses:
72.1_1,2 Applied Music
75.131,2 Intro to Keyboard (non-keyboard majors)
71.101 Theory I
71.103 Aural Skills I Ensemble, one semester; and
4. a successful audition is required, for

which repertoire is developed in consultation with the appropriate applied studio faculty.

Retention in Performance Specialization

1. A minimum grade of B is required for each ensemble and performance specialization course;
2. a grade point average of 2.500 must be maintained for all music courses;
3. continued full-time enrollment in the prescribed curriculum is required;
4. a senior recital is required during the same semester in which the applied music sequence is completed;
5. performance in the Department of Music recital hour is required during each semester of residency.

Course of Study for Performance Specialization (Bachelor of Music)

Freshman Year

Fall Semester

72.100	Recital Attendance	0
71.101	Music Theory 1	3
71.103	Aural Skills 1	1
72.1-1	Applied Music 1	2
76.—	Ensembles	2
75.131	Intro to Keyboard 1	1
74.101	Intro to European Art Music 1	1
42.101	Gen Ed - College Writing I	3
	Gen Ed - Math	3
total:		16

Spring Semester

72.100	Recital Attendance	0
71.102	Music Theory 2	3
71.104	Aural Skills 2	1
72.1-2	Performance Applied 1	3
76.—	Ensembles	2
75.132	Intro to Keyboard 2	1
74.102	Intro to Non-European Musics	1
42.102	Gen Ed-College Writing	3

42.102	Gen Ed- College Writing II	3
total:		16

Sophomore Year

Fall Semester

72.100	Recital attendance	0
71.201	Music Theory 3	3
71.203	Aural Skills 3	1
72.2-1	Performance Applied 2	3
76.—	Ensembles	2
74.261	Music History 1	3
75.233	Conducting 1	2
75	Performance Elective	3
total:		17

Spring Semester

72.100	Recital Attendance	0
71.202	Music Theory 4	3
71.204	Aural Skills 4	1
72.2-2	Performance Applied 3	1
76.	Ensembles	2
74.262	Music History 2	3
75.	Performance Elective	3
75.234/5	Conducting 2(w/lab)	2
total:		17

Junior Year

Fall Semester

72.100	Recital Attendance	0
72.3-1	Performance Applied 4	3
76.	Ensembles	2
75.493	Performance Seminar 1	3
	Upper Level Music Elective	3
76.	Chamber Ensemble	1
	Gen Ed. Lab Science	3-4
total:		15-16

Spring Semester

72.100	Recital Attendance	0
72.3-2	Performance Applied 5	3
76.	Ensembles	2
75.494	Performance Seminar 2	3
76.	Chamber Ensemble	1
	Gen Ed: Lab Science	3-4
	Gen Ed: BS, SS	3
total:		15-16

Senior Year**Fall Semester**

72.100	Recital Attendance	0
76.	Ensembles	2
72.	Performance Applied 6	3
	Upper Level Music Elective	3
76.	Chamber Ensemble	1
	Gen Ed- Beh & Soc St	3
	Gen Ed- Values, C & C	3
total:		15

Spring Semester

72.	Performance Applied 7	3
76.	Ensembles	2
76.	Chamber Ensemble	1
72.499	Senior Recital	1
	gen Ed: Science	3
	Gen Ed: Literature	3
total:		13

TOTAL CREDITS: 122- 124

Performance: Emphasis in Sound Recording Technology

Though prospective Sound Recording Technology students enroll in certain specific courses for their specialization in the sophomore year, retention in the program requires an application to the Program Coordinator prior to the junior year. (see sophomore year retention)

General Requirements for Retention and Graduation

- Sophomore Year Retention
 - completion of 71.103, 71.104, & 71.203;
 - a minimum of 2.500 GPA in sound recording, mathematics, and physics coursework; and
 - successful completion of Applied 4.
- Junior Year Retention
 - 3.000 GPA in all sound recording technology coursework; and
 - 2.500 GPA in electrical engineering, physics, and mathematics course work.
- Graduation Requirements
 - 2.500 cumulative GPA;

b. 3.000 GPA in all sound recording technology and support courses; and

c. completion of approved senior tape project.

Course of Study for Performance: Sound Recording Technology Emphasis (Bachelor of Music)**Freshman Year****Fall Semester**

72.100	Recital Attendance	0
71.101	Music Theory 1	3
71.103	Aural Skills 1	1
72.1-1	Applied Music 1	2
76.—	Ensembles	2
75.131	Intro to Keyboard 1	1
74.101	Intro to European Art Music 1	1
42.101	Gen Ed - College Writing I	3
92.131	Calculus I	4
total:		17

Spring Semester

72.100	Recital Attendance	0
71.102	Music Theory 2	3
71.104	Aural Skills 2	1
72.1-2	Applied Music 2	2
76.—	Ensembles	2
92.132	Calculus II	4
74.102	Intro to Non-European Music 1	1
42.102	Ged Ed - College Writting II	3
total:		16

Sophomore Year**Fall Semester**

72.100	Recital Attendance	0
71.201	Music Theory 3	3
71.203	Aural Skill 3	1
72.2-1	Applied Music 3	2
76.	Ensembles	2
49.201	Economics 1	3
74.261	Music History 1	3
	Ged Ed - Lit	3
total:		17

Spring Semester

72.100	Recital Attendance	0
71.202	Music Theory 4	3
71.201	Aural Skills 4	1
72.2-2	Applied Music 4	2
76.	Ensembles	2
74.262	Music History 2	3
78.31	Intro to Recording	3
95.101	Intro to Physics	3
96.101	Intro to Physics lab	1
total:		18

Junior Year**Fall Semester**

72.100	Recital Attendance	0
72.3-1	Applied Music 5	2
76.	Ensembles	2
78.41	Recording Producing (w/ lab)	3
78.36	Critical Listenting	3
78.39	Acoustic & Psychoacoustics	2
75.233	Conducting 1	2
total:		15

Spring Semester

72.100	Recital Attendance	0
72.3-2	Applied Music 6	2
76.	Ensembles	2
75.234/5	Conducting 2 (w/ lab)	2
78.411	Audio Theory (w/ lab)	3
16.211	Fund of Sound Recording	3
78.35	Video Production	3
	Upper Level Music Elective	3
total:		18

Senior Year**Fall Semester**

72.100	Recital Attendance	0
76.	Ensembles	2
78.45	The Recording Industry	3
78.47	Rec Studio Rep & Main	3
78.44	Multitrack Recording	3
*78.492	SRT Internship Preparation	2
total:		13
*78.494-	SRT Senior Project may be	

substituted for 78.492/493

Spring Semester

*78.493	SRT Internship Residency	4
	Gen Ed - Beh & Soc St	3
	Ged Ed - Values, C & C	3
91.211	Comp Sci for SRT Appl	3
	total:	13
	TOTAL CREDITS	127

Sound Recording Technology Internship Policies

Internships in Sound Recording Technology are governed by the following policies. Specific written authorization of the Coordinator of Sound Recording Technology, given prior to the internship experience, is required for any deviations in these policies.

1. The internship may only be undertaken after the student has successfully completed the courses: 78.410 and 78.411;
2. the student must have a cumulative grade point average of 2.500 or higher and a GPA of 3.000 in Sound Recording Technology and support courses prior to undertaking the internship, to insure that students are academically prepared for the study;
3. students register for 78.492 Internship Preparation the semester prior to residency, for the purposes of researching and securing the internship;
4. the internship shall be for a period of fifteen weeks. A minimum of fifteen to twenty hours per week is to be spent at the location of the internship sponsor, working as assigned. It is expected that twenty hours per week will be the norm; additional hours are strongly encouraged, but not required;
5. the student is registered under course 78.493 Internship in Sound Recording Technology for four credit hours. The intern must be registered as a full-time student during the semester of the internship unless by special exemption. If necessary, the student will register for one or two sections of "Directed Studies in SRT" to reach the credit load of a full-time student;
6. the student/intern shall receive no compensation and shall be considered a full-time student undertaking studies with the intern sponsor. The sponsor

shall not be held responsible for Workman's Compensation, Disability Insurance, Unemployment Insurance, and other legal obligations normally assumed for regular employees. The intern shall provide his or her own accident and health insurance;

7. where circumstances are appropriate, the internship sponsor may arrange to reimburse the intern for housing, board, travel, and incidental expenses; and
8. the student will solicit the internship, and interview with the internship sponsor prior to the beginning of the internship experience. In the event that the SRT program is solicited by a prospective internship sponsor and a student is recommended by the Coordinator of Sound Recording Technology, it remains the student's responsibility to interview and otherwise arrange for the internship.

Performance: Emphasis in Music Business

As an alternative to the traditional music degree program, the Bachelor of Music degree in Performance: Emphasis in Music Business combines a traditional music curriculum with courses and experiences related to the Music Industry. The program focuses on music business, management, marketing, sales, publishing, retailing, promotion, record and concert promotion and management, and prepares graduates knowledgeable in all aspects of the Music Industry.

Though prospective Music Business students enroll in certain specific courses for their specialization in the freshman year, retention in the program requires an application to the Program Coordinator prior to the sophomore year.

Internship

The Internship experience is an important bridge between academic preparation and career development. The student must have completed all required courses and is expected to have acquired the necessary knowledge to be successful in the Music Business Industry. Students undertake an Internship at a professional firm involved in some facet of the Music Industry.

Additional Information

Additional regulations and policies regarding the Internship are available in the Music Business Student Handbook distributed to each student enrolled in the Bachelor of Music in Performance: Emphasis in Music Business program.

General Requirements for Retention and Graduation

Minimum grade point requirements must be maintained in order to continue as a Music Business major. At the conclusion of each semester students will input their courses and grade information into the computerized Declaration of Intent to Graduate Form and present the disk and a printed copy along with a transcript to their advisor. Grade point averages and completed course information will be used to select appropriate future courses. The Declaration of Intent to Graduate Form Program will automatically calculate the grade point average for the three areas of concern: Music Courses, Music Business Courses and total Grade Point Average. The minimum grade point requirements are as follows:

Music Courses	2.500
Music Business Courses	3.000
Cumulative Grade Point Avg.	2.500

If any of these standards are not met, the student will be suspended from the program and will not be allowed to enroll in courses within the major. Student will repeat any Music Business course in which they received a grade of D or below and, upon receiving a minimum grade of CD or better, will be readmitted to the program.

Course of Study for Performance: Music Business Emphasis (Bachelor of Music)

Freshman Year

Fall Semester

72.100	Recital Attendance	0
71.101	Music Theory 1	3
71.103	Aural Skills 1	1
72.1-1	Applied Music 1	2
76.—	Ensembles	2
75.131	Intro to Keyboard 1	1

74.101	Intro to European Art Music	1
42.101	Gen Ed - College Writing I	3
	Gen Ed - Lab Science	3-4
	total:	16-17

Spring Semester

72.100	Recital Attendance	0
71.1	Music Theory 2	3
71.1	Aural Skills 2	1
72.1-2	Applied Music 2	2
76.—	Ensembles	2
77.2	Computers in Music Business	3
74.1	Intro to Non-European Musics	1
42.1	Gen Ed - College Writing II	3
	total:	15

Sophomore Year**Fall Semester**

72.100	Recital Attendance	0
71.201	Music Theory 3	3
71.203	Aural Skills 3	1
72.2-1	Applied Music 3	2
76.	Ensembles	2
75.233	Conducting 1	2
77.301	Music Business 1	3
60.201	Accounting / Financial	3
	total:	16

Spring Semester

72.100	Recital Attendance	0
71.2	Music Theory 4	3
71.2	Aural Skills 4	1
72.2-2	Applied Music 4	2
76.—	Ensembles	2
75.234	Conducting 2 (w/ lab)	2
77.3	Music Business 2	3
60.2	Accounting / Managerial	3
	total:	16

Junior Year**Fall Semester**

72.100	Recital Attendance	0
72.3-1	Applied Music 5	2
76.	Ensembles	2

74.261	Music History 1	3
65.301	Bus Soc & Pub Pol (Gen Ed - VC)	3
49.201	Economic 1 (Gen Ed - BS)	3
77.304	Promo & Merchandising	3
	total:	16

Spring Semester

72.100	Recital Attendance	0
72.3-2	Applied Music 6	2
76.	Ensembles	2
74.26	Music History 2	3
77.3	Publishing & Copyinght	3
49.2	Economics II	3
	Gen Ed - Lab Science	3-4
	total:	16-17

Senior Year**Fall Semester**

72.100	Recital Attendance	0
76.	Ensembles	2
77.401	Music Business Seminar	3
77.404	Music Entrepreneurship	3
	Upper Level Music Elective	3
	Gen Ed - Science	3
	total:	14

Spring Semester

77.5	Music Business Internship	3
78.31	Survey of Music Technology	3
	Gen Ed - Literature	3
92.18	Intrp to Statistics (Gen Ed - Math)	3
41.26	Legal Concepts (Gen Ed - BS)	3
	total:	15

TOTAL CREDITS: 124 - 126

Music Teaching Preparation**Admission Requirements**

1. Though prospective Music Teaching Preparation students may take some elective courses for their specialization in the freshman and sophomore years, admission to the program of professional studies requires formal application to the Coordinator of Music Education prior to the junior year but no later than upon completion of 60 credit hours;

2. prospective music teaching preparation students must pass courses in music including Music Theory, Aural Skills, Conducting, Music History, Applied Music, and Ensembles;
3. prospective music teaching preparation students must pass two semesters of College Writing with a grade of 'C' or better; and
4. prospective music teaching preparation students must achieve a cumulative average of 2.750 or better overall and achieve the same cumulative average in the aggregate of music courses.

Retention Requirements

Students must maintain a minimum of 2.750 cumulative average in all coursework attempted.

Application for Professional Certification

For students seeking teacher certification, a graduate degree program that includes music education course work and then student teaching practicum is available at the University. Students may apply to this program immediately following completion of the undergraduate degree program or may seek early admission to the M.M. degree program during their senior year. Completion of the undergraduate program does not automatically lead to acceptance into the Master of Music degree program. Students who perform well in the undergraduate program will, however, be well prepared to meet the standards for admission into the University's graduate program in Music Education.

Upon completion of the M.M. degree program, students may file an application to the Massachusetts Department of Education for initial certification at the advanced provisional stage. When the application materials are complete, the College of Arts and Sciences recommends the graduate for teaching certification and forwards these materials to the office of the Dean, Graduate School of Education. The School of Education forwards all teacher certification applications to the Massachusetts Department of Education which is solely responsible for granting certification. As of April 1998, candidates for certification will also be required to pass a test of communication and literacy skills and the appropriate subject test (music) before the certificate will be

granted. Information on the Massachusetts Educators Certification Tests is available from the Massachusetts Department of Education or from National Evaluation Systems located in Hadley, MA.

Course of Study for Music Teaching (Bachelor of Music)

Freshman Year

Fall Semester

72.100	Recital Attendance	0
71.101	Music Theory 1	3
71.103	Aural Skills 1	1
72.1-1	Applied Music 1	2
76.—	Ensembles	2
75.131	Intro to Keyboard 1	1
74.101	Intro to European Art Music 1	
42.101	Gen Ed - College Writing I	3
92.111	Math Perspectives	3
total:		16

Spring Semester

72.100	Recital Attendance	0
71.102	Music Theory 2	3
71.104	Aural Skills 2	1
72.1-2	Applied Music 2	2
76.—	Ensembles	2
73.151	Intro to Music Ed	2
74.102	Intro to Non-European Musics	1
42.102	Gen Ed - College Writing II	3
75.132	Intro to Keyboard 2	1
total:		15

Sophomore Year

Fall Semester

72.100	Recital Attendance	0
71.201	Music Theory 3	3
71.203	Aural Skills 3	1
72.2-1	Applied Music 3	2
76.	Ensembles	2
47.26	Human Dev I	3
74.261	Music History 1	3
73.142	Intro to Guitar	1
total:		15

Spring Semester

72.100	Recital Attendance	0
71.202	Music Theory 4	3
71.294	Aural Skills 4	3
72.2-2	Applied Music 4	2
76.	Ensembles	2
74.262	Music History 2	3
73.243	Intro to Voice	1
	Gen Ed - Literature	3
total:		15

Junior Year

Fall Semester

72.100	Recital Attendance	0
72.3-1	Applied Music 5	2
76.	Ensembles	2
	Gen Ed - Science w/ lab	3/4
	Gen Ed - Beh/Social Sciences	3
73.242	Intro to Strings	1
75.233	Conducting 1	2
7x.xxx	Upper Level Music Elective	3
total:		16-17

Spring Semester

72.100	Recital Attendance	0
72.3-2	Applied Music 6	2
76.	Ensembles	2
75.234/5	Conducting 2 (w/ lab)	2
73.xxx	Prepracticum Fieldwork	3
	Gen Ed - Scical w/lab	3/4
	Gen Ed - Social Science	3
73.162	Intro to Percussion	1
total:		16/17

Senior Year

Fall Semester

72.100	Recital Attendance	0
76.	Ensembles	2
72.4-1	Applied Music 7	2
73.141	Intro To Brass	1
7x.xxx	Upper Level Music Elective	3
	Gen Ed - Science	3
73.394	Chor Reper/Reh Tech	3
73.493	Choral Ensembles Lab	1
total:		15

Spring Semester

73.144	Intro to Woodwinds	1
76.	Ensembles	2
72.4-2	Applied Music 8	2
73.493	Instrumental Ensemble Lab	1
73.201	Computers in Music Ed	3
73.397	Contemporary Methods	3
73.393	Inst Reper/Reh Tech	3
total:		15
TOTAL CREDITS:		125-125

Music Theory and Aural Skills Courses (Prefix: 71)

71.100 Fundamentals of Musicianship

A study of the basic visual and aural symbols of music and their application to music comprehension. Offered summers only. 3 cr.

71.101 Music Theory 1

A review of music fundamentals (scales, keys, intervals and triads), followed by seventh chords, chord symbols, figured bass, harmonic function, cadences, embellishing tones, harmonization, and principles of four-part writing. Study also includes score analysis and brief composition projects. Music majors only. 3 credit hours.

71.102 Music Theory 2

Building on the foundation of Music Theory 1, this course includes part-writing with non-chord tones and inversions, melody, melodic reduction, large-scale arpeggiation, dominant and non-dominant seventh chords, secondary dominants, modulation, and simple binary and ternary forms. Study includes score analysis and composition projects. Music majors only. 3 credit hours. Prerequisite: 71.101

71.103 Aural Skills 1

Development of basic sight singing, listening, and dictation skills as they relate to music theory and analysis. Activities include singing (using moveable do/tonic do solmization), listening, and dictation (melodic, harmonic and rhythmic) of diatonic music. Music majors only. 1 credit hour.

71.104 Aural Skills 2

Development of basic sight singing, listening and dictation skills as they relate to

music theory and analysis. Activities include singing (using moveable do/tonic do solmization), listening, and dictation (melodic, harmonic and rhythmic) of more diatonic music. Music majors only. 1 credit hour. Prerequisite: 71.101 and 71.103

71.110 Basic Music Theory

A study of the symbolics of music and their application to the comprehension of the architectural, organizational and aural elements of music literature. Non-music majors only. 3 credit hours.

71.201 Music Theory 3

The study of 18th century contrapuntal practices. Further study includes Neapolitan and augmented sixth chords, modal borrowing, third relations, chromatic and enharmonic modulation, compound ternary, sonata and rondo forms, and 19th century chromatic devices such as expanded tonicization and harmonic sequence. Study includes score analysis and composition projects. Music majors only. 3 credit hours. Prerequisite 71.102

71.202 Music Theory 4

Starting with the chromaticism of the late 19th century, including linear harmonies and dominant 9th, 11th and 13th chords, this course explores the expansion of tonal practice through its ultimate dissolution and transformation. Alternate harmonic and scalar structures and techniques of the 20th century will be studied, including pandiatonicism, polytonality, asymmetry, intervallic organization, social procedures, indeterminacy, and minimalism. Study includes score analysis and composition projects. Music majors only. 3 credit hours. Prerequisite 71.201

71.203 Aural Skills 3

Development of basic sight singing, listening and dictation skills as they relate to music theory and analysis. Activities include singing (using moveable do/tonic do solmization), listening, and dictation (melodic, harmonic and rhythmic) of chromatic and modulating music. Music majors only. 1 credit hour. Prerequisite: 71.102 and 71.104

71.204 Aural Skills 4

Development of basic sight singing, listening and dictation skills as they relate to music theory and analysis. Activities include singing (using moveable do/tonic do solmization), listening, and dictation (melodic, harmonic and rhythmic) of chromatic, modal, octatonic, and atonal music. Music majors only. 1 credit hour. Prerequisite: 71.201 and 71.203

Prerequisite: 71.201 and 71.203

71.315 Composition

An application of various techniques of musical composition. Class compositions will be performed and critiqued. 3 credit hours. Prerequisite: 71.201

71.335 Arranging

Analysis and practical application of techniques of scoring for vocal and instrumental combinations in varied configurations. Scoring projects for in-class performance, effective arranging of music in a variety of styles, and problem solving for the arranger will be included. 3 credit hours.

71.402 Eighteenth Century Counterpoint

A study of the contrapuntal practices of the eighteenth century, with an emphasis on the music of J.S. Bach. Representative works are heard and analyzed and original idiomatic writing is required. 3 credit hours. Prerequisite: 71.202

71.450 Pedagogy of Theory

Designed to prepare students to teach music theory. This course will study teaching techniques, philosophy and organization of music theory classes, as well as review appropriate texts and software. As part of the course, students will be required to prepare and present lessons to the class. 3 credit hours. Prerequisite: 71.202

71.451 Form and Analysis

A study of the structure and organizational principles of music. Prerequisite: 71.202. 3 cr.

71.490 Theory Review 1

A review of tonal harmony. Topics include triads, dominant and non-dominant sevenths, harmonic function and progression, embellishing tones, harmonization/part-writing, phrase structure and cadences, secondary dominants, modulation, Neapolitan and augmented sixth chords. Credit cannot be applied towards any music degree. 3 credit hours. Prerequisite: 71.202

71.491 Theory Review 2

A review of chromatic harmony, and an introduction to 20th century harmony and techniques. Topics include borrowed chords, chromatic third relations, chromatic and enharmonic modulation, enharmonic use of chords, extended tertian harmonies, quartal harmony, modality, set theory, and serial procedures. Credit cannot be applied towards any music degree. 3 credit hours. Prerequisite: 71.202

Prerequisite: 71.202

71.495 Directed Study in Music Theory

Individual work under the supervision of a member of the music theory faculty on a wide variety of topics approved by the instructor and the theory faculty. Permission of chairperson required. 3 credit hours.

71.498 Seminar in Music Theory

An intense study of advanced topics in music theory. 3 credit hours.

Applied Music Courses (Prefix: 72)

72.100 Recital Attendance

Required attendance at scheduled Thursday Recital Hours and ten concerts/recital each semester from those listed on the Department of Music Performance Calendar. Seven semesters required of all music majors. 0 credit hours.

72.101-402 Applied Keyboard 1-8

Studio instruction in graduated sequence with keyboard as the principal instrument. 2 credit hours.

72.111-412 Applied Voice 1-8

Studio instruction in graduated sequence with voice as the principal instrument. 2 credit hours.

72.121-422 Applied Woodwinds 1-8

Studio instruction in graduated sequence with woodwind as the principal instrument. 2 credit hours.

72.131-432 Applied Brass and Percussion 1-8

Studio instruction in graduated sequence with brass or percussion as the principal instrument. 2 credit hours.

72.141-442 Applied Strings 1-8

Studio instruction in graduated sequence with strings as the principal instrument. 2 credit hours.

72.152-452 Performance Keyboard 1-7

Studio instruction in graduated sequence with keyboard as the principal instrument for performance majors. 3 credit hours.

72.162-462 Performance Voice 1-7

Studio instruction in graduated sequence with voice as the principal instrument for performance majors. 3 credit hours.

72.172-472 Performance Woodwinds 1-7

Studio instruction in graduated sequence with woodwind as the principal instrument for performance majors. 3 credit hours.

72.182-482 Performance Brass and Percussion 1-7

Studio instruction in graduated sequence with brass or percussion as the principal instrument for performance majors. 3 credit hours.

72.192-492 Performance Strings 1-7

Studio instruction in graduated sequence with strings as the principal instrument for performance majors. 3 credit hours.

72.499 Senior Recital

Public performance to be presented, registered concurrently with Applied Music 8 or Performance Applied Music 7. 1 credit hour.

Music Teaching Courses (Prefix: 73)**73.141 Introduction to Brass**

Intensive class instruction toward the development of basic performance proficiency on brass instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 1 credit hour.

73.142 Introduction to Guitar

Class instruction in the performance and pedagogical fundamentals of playing and teaching guitar. The student is expected to learn basic accompaniment and performance skills in addition to techniques for beginning guitar instruction. 1 credit hour.

73.144 Introduction to Woodwinds

Intensive class instruction toward the development of basic performance proficiency on woodwind instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 1 credit hour.

73.151 Introduction to Music Education

Designed to provide the student with an overview of the principles and practices of music education in today's public schools.

Students will observe regular classrooms and music instruction at all levels of N-12 education. This course is a prerequisite for all professional education courses in music education and includes the component of required pre-practicum fieldwork. 2 credit hours.

73.162 Introduction to Percussion

Intensive class toward the development of basic performance proficiency on percussion instruments and the development of pedagogical skills techniques for beginning instruction and demonstration purposes. 1 credit hour.

73.201 Computers in Music Education

Introduction to the role of computers and technology, including use of MIDI and other educational tools in music education programs. Course stresses the development of computer literacy, including knowledge of word processing, database, and spreadsheet applications as essential tools for educators. 3 credit hours.

73.242 Introduction to Strings

Intensive class instruction toward the development of basic performance proficiency on string instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 1 credit hour.

73.243 Introduction to Voice

Intended to cultivate the fundamental principles of singing. The psychology of singing and physiology of the singing voice are considered as they apply to tone production and resonance. This course is designed for non-voice majors. 1 credit hour.

73.370 Historical and Philosophical Principles and Practices in Music Education

Comprehensive survey of the historical, philosophical, sociological, psychological and political factors that affect American schools, particularly as they impact upon current principles and practices in the discipline of music education. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork in the form of observations and interviews. 4 credit hours.

73.392 General Music Methods

A course designed to present the basic fundamentals of music pedagogy, includ-

ing lesson planning and the writing of instructional objectives, with a focus on general music instruction at all levels. The course discusses basic principles of curriculum and instruction, assessment issues, national and state standards/curriculum frameworks, and learning styles and development stages as related to instructional modes and strategies. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork in the form of observations, assisting experiences, and actual teaching in school settings. 4 credit hours.

73.393 Instrumental Repertoire and Rehearsal Techniques

Examination of appropriate instrumental repertoire for the secondary school level and effective instrumental rehearsal techniques. Includes study of rehearsal planning, score preparation, and the development of fundamental musicianship skills necessary for a successful instrumental ensemble. 3 credit hours.

73.394 Choral Repertoire and Rehearsal Techniques

Examination of appropriate choral repertoire for the secondary school level and effective choral rehearsal techniques. Covers auditioning, warmups, choral tone, diction, score preparation, and development of fundamental musicianship skills necessary for a successful choral ensemble. Serves as a choral laboratory setting for the practice of score preparation and rehearsal techniques. 3 credit hours.

73.397 Contemporary Methodologies

Investigation of some of the most popular methods of teaching music, including Kodaly, Orff, Dalcroze, and comprehensive musicianship. Discussion of contemporary issues including music in special education and multicultural music education. As one of the core professional music education courses, includes the component of fieldwork in selected settings. 3 credit hours.

73.493 Instrumental Ensemble Lab

Designed to supplement the experiences of the instrumental methods courses. Students gain experience performing on secondary instruments, planning lessons for beginning and intermediate level instrumental ensembles, and conducting in these settings. 1 credit hour.

73.494 Choral Ensemble Lab

Designed to supplement the experiences of the choral and vocal methods courses. Students gain experience by planning lessons for elementary and secondary school level vocal ensembles and conducting in these settings. 1 credit hour.

73.496 Directed Study in Music Education

Individual work under the supervision of a member of the music education faculty on a specific topic approved by the instructor and the music education faculty. Permission of Coordinator of Music Education required. 3 credit hours

**Music History Courses
(Prefix: 74)****74.101 Introduction to European Art Music**

An aural introduction to the various types of European concert music from the 18th through the 20th century. This course emphasizes aural acquaintance with literature and genre and consists of in-class listening and discussion designed to enhance the aural experience. Required of all first year music majors as a prerequisite to Music History 1 and 2. 1 credit hour.

74.102 Introduction to Non-European Musics

An introduction to selected world musics from a contextual perspective which explores music as an integral part of both society and culture and its function in labor, ritual and celebration. Aspects of instrumental classification, spontaneity and improvisation, as well as elements of music as both organized sound and silence in all cultures will be considered. This includes timbre, melody, rhythm, harmony, form, and texture. Required of all first year music majors as a prerequisite to Music History 1 and 2. 1 credit hour

74.161 Music of Western Civilization

A survey of music from earliest times to the present. Significant forms, styles, composers and aesthetic concepts are examined. Open to non-music majors only. 3 credit hours.

74.261 Music History 1

A survey of sacred and secular musical forms, styles and ideas in their historical and cultural contexts, from antiquity to approximately 1750. Special emphasis is

given to the period after the invention of music printing, from 1500 on. The course entails listening and score study. 3 credit hours.

74.262 Music History 2

A survey of common practice musical forms, styles and ideas in their cultural and historical contexts, from approximately 1750 to the present. The course entails listening and score study. 3 credit hours.

74.301 American Music

A historical, cultural and contextual survey of diverse styles of concert and vernacular music in the United States from the colonial era to the present. Open to music and non-music majors. 3 credit hours.

74.320 African-American Concert Music

African-American concert Music is a survey of orchestral works by Black classical composers starting from the 1890s through the Harlem Renaissance to present-day composers. Open to music majors and non-music majors. 3 credit hours.

74.355 Jazz

An intense study of the history of jazz from its origins to the present, covering a wide selection of styles and schools of jazz in various ensemble configurations. Open to music and non-music majors. 3 credit hours.

74.356 American Musical Theatre

A contextual study of the American stage musical and its development from the late 18th century to the present, with particular emphasis on the 20th century and on the ways in which shows of a given era reflect or disrupt the culture and discourse of that era. 3 credit hours.

74.386 Rock & Roll

Rock & Roll will trace the roots of American popular music from its origins and influences from the earliest European song forms to American folk songs, gospel, country, rhythm and blues, jazz, and other popular forms up through current trends as related to the development of the music industry and other socio-musical influences of the commercial song from the 1500s to the present. 3 credit hours.

74.451 History of Choral Music

A study of the stylistic and compositional approaches to choral music from

Ockegham to Stravinsky. 3 credit hours. Prerequisite: 74.261, 74.262

74.454 Symphony

A study of the stylistic and compositional approaches to symphony. 3 credit hours. Prerequisite: 74.261, 74.262

74.455 Women in Music

Survey of the role of women in music from ancient times to the present, with primary emphasis on composers of art music in the western tradition. Open to music and non-music majors. 3 credit hours.

74.462 Music of the Renaissance

A study of mass, motet, chanson, madrigal and instrumental music of the fifteenth and sixteenth centuries. 3 credit hours. Prerequisite: 74.261

74.463 Music of the Baroque Era

A stylistic study of the music of the period from 1600-1750. 3 credit hours. Prerequisite: 74.262

74.464 Music of the Classic Era

A study of the solo, chamber, symphonic and operatic literature from 1720-1827. 3 credit hours. Prerequisite: 74.262

74.465 Music of the Romantic Era

A study of representative vocal, instrumental, and operatic works from Beethoven through Richard Strauss with emphasis on stylistic characteristics, catalogues of the composers, and related aesthetic movements including writers, poets, and painters of the 19th century such as Rousseau, Schoepenhauer, Hegel, Schiller, Pushkin, and J.J.W. Turner. 3 credit hours. Prerequisite: 74.262

74.466 Music of the Early Twentieth Century

An examination of the stylistic trends of music from late Romanticism to mid-century. Emphasis is on listening and analysis, as well as musicological commentary. 3 credit hours. Prerequisite: 74.262

74.495 Directed Study in Music History

Individual work under the supervision of a member of the music history faculty. May be repeated with permission of the chairperson. 3 credit hours.

74.498 Seminar in Music History

An intense study of advanced topics in music history. 3 credit hours. Prerequisites: 74 261, 74 262, at least four

74-prefix courses at the 300-level or above, and permission of instructor.

Performance Courses (Prefix: 75)

75.131 Introduction to Keyboard 1

The emphasis is placed on such keyboard skills as the playing of several scale forms, basic chord progressions, harmonization of melodies, accompaniment patterns, basic solo literature, development of keyboard reading necessary to a working knowledge of the keyboard and basic improvisational concepts. 1 credit hour.

75.132 Introduction to Keyboard 2

A study of more advanced chord progressions, ensemble keyboard playing, patriotic songs, more advanced accompaniment patterns and advanced solo literature and a continuation of the use of improvisational techniques. 1 credit hour. Prerequisite: 75.131

75.233 Conducting 1

Training in basic baton technique and related study for instrumental and choral conducting. 2 credit hours.

75.234 Conducting 2

Continuation of 75.233 exploring more advanced choral and instrumental conducting techniques. 1 credit hour.

75.235 Conducting 2 Lab

Directed toward extension and refinement of conducting skills. 1 credit hour.

75.253 Keyboard Pedagogy

Emphasis on studio teaching of beginning, intermediate and advanced students. Aspects of establishing and maintaining a studio (business aspects, tax, equipment, bookkeeping, etc.). Survey of literature for teaching purposes; ways of approaching various concepts, such as reading notes, rhythmic understanding, dynamics, etc. 3 credit hours.

75.265 Jazz Keyboard 1

A study of chord progressions, blues scales, chord voicings and melodic harmonization with emphasis on improvisation. 3 credit hours.

75.266 Jazz Keyboard 2

A continuation of 75.265. Will introduce the use of chord substitutions and extensions, melodic analysis, the study of various piano styles. Main emphasis on advanced improvisation. 3 credit hours.

Prerequisite: 72.265

75.333 Conducting 3

A continuation of Conducting 2 (75.234) for advanced students. Permission of instructor required. 3 credit hours. Prerequisite: 75.234

75.353 Applied Keyboard Repertoire

The study and performance of smaller and larger works common to the keyboard repertoire: song form, minuet and trio, prelude, intermezzo, nocturne, impromptu, bagatelle and sonata allegro. 3 credit hours.

75.361 Jazz Improvisation 1

A study of basic jazz structures, motives, chord progressions, scales, melodic analysis, use of some approach techniques, tensions and their application to improvisation. Includes in class performance by small instrumental and/or vocal groups. 3 credit hours.

75.362 Jazz Improvisation 2

A continuation of 75.361. Will emphasize the study and performance of more advanced levels of improvisation. 3 credit hours. Prerequisite: 75.361

75.383 Orchestral Repertoire for Winds and Percussion

Designed as a repertoire reading session dealing with the standard literature of the symphony orchestra, with emphasis on the larger works that are heavily scored for winds. The majority of class time will be devoted to a study of articulation, style, intonation and phrasing as these aspects of the music under consideration relate specifically to the wind instruments. 3 credit hours.

75.384 Contemporary Repertoire and Performance Techniques

Designed to acquaint the student with various techniques and specialized notational practices from the contemporary repertoire through actual rehearsals, demonstrations and possible student performances. Open to non-performance majors with permission of the instructor. 3 credit hours.

75.394 Performance Seminar 1

The study and performance of selected works from the repertoire of each of the five primary areas of performance; keyboard, voice, woodwinds, strings, and brass/percussion. Emphasis will be placed on student and faculty performance, lead-

ing to detailed consideration of the relationship between the demands of the composer and the problems of the performer and the manner in which these concerns influence the musical and artistic judgments necessary to achieve a quality performance. 3 credit hours.

75.463 Vocal Pedagogy

The study of current techniques in vocal pedagogy examined through discussion, interviews, observation of studio teaching, demonstrations and outside readings. During the second half of the semester, class members are assigned to teach students who have had little or no vocal training. Class members are expected to do some research work on vocal repertoire for beginners and advanced students. The course is also appropriate for conductors and accompanists. 3 credit hours.

75.464 Diction for the Singer 1

The course is designed to acquaint the singer, conductor and accompanist with techniques of enunciation in Italian, German and French as related to the English language. Will include a comparison of sung and spoken language. Students will also learn the International Phonetic Alphabet, which applies for all languages. Song repertoire assignments and performance exercises will be utilized. 3 credit hours.

75.465 Diction for the Singer 2

Continuation of 74.464. 3 credit hours.

75.466 Solo Song Repertoire and Performance

An extensive study and research of solo song literature in German, French, Italian and English from all major periods of history. The class will also focus on various historical backgrounds, styles of important composers and poets from many different nations. Students will learn how to select suitable songs appropriate to the basic physical nature of individual voices, as well as the various stages of vocal and intellectual maturity. The class will be exposed to the concepts of preparing, memorizing, performing, recital program building and stage deportment. Students are expected to perform for the class frequently throughout the semester. 3 credit hours.

75.474 Practical Intonation

The study of orchestral and band instruments relative to intonation. The develop-

ment of conceptual awareness relative to the various characteristics of pitch, which are inherent in the design of the various instruments. Identification of problematic intonation and procedures to alleviate problems through performance. 3 credit hours.

75.493 Performance Seminar 2

Designed as a "master class" experience for students in each of the five primary areas of performance; keyboard, voice, woodwinds, strings, and brass/percussion, with a separate section for each area wherever possible. Class sessions will consist of student performance of selected literature followed by critical analysis from faculty and peers. Each section will be supervised by the appropriate area coordinator, and will also involve invited guest performers selected from faculty, applied faculty and other noted artists. 3 credit hours. Note: 75.394 is not a prerequisite for 75.493

75.495 Directed Study and Research in Performance

Permission of chairperson required. 3 credit hours.

Ensembles Courses (Prefix: 76)

76.101 Chamber Orchestra

Open to all students by audition. Works from the orchestral

repertoire are studied and publicly performed with additional opportunities for solo accompaniment. 2 credit hours.

76.103 Wind Ensemble

Open to all students by audition. Compositions are selected from a wide repertoire of wind ensemble literature for study and performance. Opportunity for solo performance with wind ensemble accompaniment. 2 credit hours.

76.105 Concert Band

Open to all students by audition. Selected band repertoire studied and performed. 2 credit hours.

76.106 Marching Band

Open to all students of the University, without regard for major field of study. The marching band performs at University events and at selected band festivals throughout New England. Custom musical arrangements and visual designs are fea-

tured. No audition required. 2 credit hours.

76.108 Studio Orchestra

Open to all students by audition. A wide spectrum of jazz orchestration and solo performance is studied and performed. 2 credit hours.

76.147 Ensemble Performance

This ensemble provides students with an introduction to the skills, knowledge, and attitudes necessary for satisfactory ensemble performance, namely: adequate technical facility for successful ensemble participation; functional knowledge of musical grammar and syntax in reference to its application in ensemble performance; proper application of aural and rhythmic skills in an ensemble setting; music sensitivity in relation to ensemble performance; and a knowledge of the protocols of ensemble preparation and performance. Emphasis on utilization of major scales and chords through application in both classical and jazz styles. 2 credit hours.

76.151 Brass Ensemble

Open to all students by audition. Provides a wide range of performance experience through varied brass literature. 1 credit hour.

76.153 Percussion Ensemble

Open to all students by audition. Exploration of the growing body of literature for percussion ensemble. Public performance. 1 credit hour.

76.155 String Quartet

Open to all students by audition. Study of the best string quartet literature. 1 credit hour.

76.156 Guitar Ensemble

Open to all students by audition. Provides study and performance of literature for guitar, lute, etc. Required of all guitar majors each semester. 1 credit hour.

76.157 Woodwind Quintet

Open to all students by audition. Offers study and performance of literature for woodwind quintet. 1 credit hour.

76.158 Piano Ensemble

Open to all students by audition. Provides performance experiences through varied piano ensemble literature for one and two pianos. 1 credit hour.

76.159 Mixed Chamber Ensemble

Open to all students by audition. Offers a

wide range of performance experience through a selection of literature for varying combinations of instruments. 1 credit hour.

76.160 String Ensemble

Open to all students by audition. Provides experience in the performance of string orchestra literature. 1 credit hour.

76.161 Small Jazz Ensemble

Open to all students by audition. Provides experience in the performance of jazz literature for groups ranging from four to eight members. 1 credit hour.

76.162 Jazz Lab Ensemble

Open to all students by audition. Provides students with a clear understanding of the skills, knowledge and attitudes necessary to satisfactory ensemble performance and practical experience in the application of such skills, knowledge and attitudes. 1 credit hour.

76.163 Mallet Ensemble

Open to all students by audition. The various mallet percussion instruments are used to provide the percussion player an opportunity to experience providing melody and harmony. 1 credit hour.

76.164 Saxophone Quartet

Open to all students by audition. Offers study and performance of literature for saxophone quartet. 1 credit hour.

76.165 Jazz Rock Big Band

Open to all students by audition. Fusion big band covering a wide variety of contemporary jazz rock literature. Solo improvisational opportunities. Numerous performances. 1 credit hour.

76.201 Concert Choir

A small, select choir open to all singers by audition. Performs music ranging from the present day to the Middle Ages. 2 credit hours.

76.202 University Choir

Open to all students by audition. Includes the study and performance of a wide variety of choral compositions. 2 credit hours.

76.210 Opera Workshop

Open to all students. Practical experience in the non-performing aspects of operatic and Broadway show production. 1 credit hour.

76.251 Fine Arts Chorale

A large chorus open to the campus and

the community without audition. Performs larger works in the choral repertoire including oratorios, masses, motets and opera. 1 credit hour.

76.253 Vocal Jazz Ensemble

Open to all students by audition. Provides experience in performing and interpreting vocal jazz literature. Professional microphone and staging techniques will be presented along with vocal improvisation. 1 credit hour.

Music Business Courses (Prefix: 77)

77.201 Computers in Music Business

An introduction into the use of Macintosh, DOS, and other computer systems and software applications used within the Music Industry. Topics will include programs, input devices, disk drives, I/O ports, peripherals, communication networks, operating systems, the internet, MIDI, sound cards, interactive multimedia, and the use of such applications as: word processors, spreadsheets, data bases, desk top publishing. 3 credit hours.

77.301 Music Business 1

A systematic look at career options in the Music Industry. Topics discussed include: songwriting, music publishing, national and international copyright law, music licensing, artist management, and concert promotion. 3 credit hours.

77.302 Music Business 2

A systematic look at career options in the Music Industry. Topics include: music merchandising, arts administration, record promotion, marketing, and distribution, radio and television broadcasting, advertising and jingle production, and film scoring. 3 credit hours.

77.303 Music Publishing, Copyright & Contracts

A thorough study of the legal environment within the Music Industry. Topics discussed include: music publishing, national and international copyright law, live performance, managers & agents, music organizations, recording agreements, music publishing, film and television music production, music merchandising, and other contractual obligations. 3 credit hours.

77.304 Music Promotion & Merchandising

A thorough study of the principles and application of marketing, promotion, and distribution of products within the Music Industry. Case studies of various music products and companies will be studied and analyzed. 3 credit hours.

77.401 Music Business Seminar

Prepares students to undertake their Internship by providing an in-depth study of how to prepare successfully to enter a career path. 3 credit hours.

77.403 Music Business Entrepreneurship

An thorough study of how to start a business within the Music Industry. Case studies of successful entrepreneurs and their companies will be researched and analyzed. Students will develop a written Business Plan for their own Music Business enterprise. 3 credit hours.

77.495 Directed Studies in Music Business

Permission of coordinator required. 3 credit hours.

77.499 Music Business Internship

Students will complete a 15-week Internship at a company in the Music Industry which offers a varied, practical, and challenging learning experience. This Internship will be supervised by a Sponsor from the company and the Coordinator of the Music Business program. 3 credit hours.

Sound Recording Technology Courses (Prefix: 78)

78.301 Music, Technology & Society

Examines how recording technology has changed music and the relationships of music and society. The course studies and evaluates the application of technology to making music, to music listening, to styles of music, and to music's roles in society, other art forms, and media. The evolving importance of technology in music over the past century is charted through the study of musical examples and through viewing how human values are reflected in this century's timely music. Studies will be based on assigned readings, lectures and discussions, examinations of current and historically significant music recordings, motion pictures and media pieces for this artistry, their use of available technology,

and their impact on human values and society. 3 credit hours.

78.305 Survey of Music Technology

The use of technology in music listening, performance, analysis, composition, recording and music study will be presented. The dimensions and applications of technology will be discussed as related to aesthetics, the musician's experiences, musical style, and the musical experience. Basic introduction to the technologies of audio recording. Course includes required reading, listening, session participation. Music Majors Only. 3 credit hours.

78.310 Introduction to Recording

The theory and usage of audio-recording/reproduction components are explored at a basic level and supplemented by hands-on experience. The aesthetics of recording media and their influence on society are discussed in relation to the artistic and commercial functions of the media. Individual research on a subject of interest to the student is required.

Prerequisite: permission of Coordinator and Chair. Music Majors. 3 credit hours.

78.350 Video Production

An introductory course in the fundamentals of video technology and production; encompassing signal transmission, tape formats, transduction, optical characteristics of lenses and cameras, production equipment and procedures, and post-production equipment and techniques; hands-on experience via video and audio for video projects. Permission of Coordinator and Chair. 3 credit hours.

78.360 Critical & Analytical Listening

The recognition and identification of timbral modifications and spatial characteristics. Aural analysis of historically significant and current music recordings for recording techniques, musical balance, performance intensity, sound quality and imaging. Development of critical listening skills and sound evaluation techniques. 3 credit hours.

78.390 Physical Acoustics and Psychoacoustics

The physical attributes of sound and acoustic measurement; displacement, time, velocity, acceleration, force, energy, resonance, wave shapes and spectral energy distribution are examined for most instruments; acoustic properties of the ear and enclosed environments; acoustic

measurements and instruments. The inter-relationships and differences of physical acoustics and psychoacoustics are stressed. 3 credit hours

78.410 Recording Production

Intermediate audio production. Planning and executing recording sessions which involve a variety of musical ensembles under diverse recording conditions; live-performance/concert recordings; multi-track recording, overdub, and remix procedures; application of informed musical judgment to the mixing process; and research in recording techniques. Laboratory required. Permission of Coordinator and Chair. 3 credit hours.

78.411 Audio Theory

Advanced audio theory. An in-depth examination of the principles and operating specifications of the major components of the modern recording studio: mastering and multi-track recorders, mixing consoles, microphones, monitoring systems, and signal processing equipment. Recording projects and technical research. Laboratory required. Permission of Coordinator and Chair. 3 credit hours.

78.420 Sound Synthesis 1

Sound synthesis equipment and techniques are studied and supplemented with sound synthesis studio laboratory work. The course will cover practices and principles of analog and digital sound synthesis and their historic origins, related audio equipment and applications, theories of sound samplers and sequencers, and an introduction to MIDI applications in sound synthesis and recording production. Permission of Coordinator and Chair. 3 credit hours. Prerequisite: 78.310.

78.421 Sound Synthesis 2

Advanced sound synthesis techniques are studied and supplemented with sound synthesis studio laboratory work. The course will cover MIDI implementation in analog and digital sound synthesis, the historic origins of computer music and electro-acoustic music, live electronic music performance, audio equipment and applications of MIDI-based and functional devices and processors, advanced music production and sound synthesis via MIDI. Permission of Coordinator and Chair. 3 credit hours. Prerequisite: 78.420

78.430 Computer Applications in Music

Applications of computers to audio pro-

duction is emphasized in studies of computer generated and controlled sound sources and devices, algorithmic composition, computer music, digital signal processing, advanced MIDI applications and programming, and computer synchronization of audio and video. Laboratory work required. SRT majors and minors. Permission of Coordinator and Chair. 3 credit hours. Prerequisite: 92.265

78.440 Multitrack Production

24-track recording. Session planning and preparation, tracking process; microphone techniques and applications; incorporating processing; planning the mix and sound stage; MIDI applications, rough mixdown. Recording project required. 3 credit hours. Prerequisite: 78.411

78.441 Advanced Multitrack Production

Advanced production techniques; tape machine calibration; automation and final mixdown; digital multitracking; SMPTE applications; premastering and mastering. Recording project required. 3 credit hours. Prerequisite: 78.440

78.450 The Recording Industry

A detailed survey of the many career options of the audio-recording industry: position duties and responsibilities. Guest lecturers from diverse careers in the industry share their experiences, disciplines, and backgrounds. Permission of Coordinator and Chair. 3 credit hours. Prerequisite: 78.310

78.460 Audio for Visuals

This course is designed to introduce students to the theory and practice of video post-production on non-linear digital editing platforms. These systems include Audio Vision, ProTools, and Sonic Solutions. Students are required to complete audio tracks for several video shorts and will learn about such diverse topics as SMMPTE, word clock, digital sync, DSP, blackburst, genlock, S/P-DIF, AES/EBU, digital recording and mixing, ADR, music beds, cues, FX, Foley recording, and random access theory and techniques. Permission of Coordinator and Chair. 3 credit hours. Prerequisite: 78.411

78.470 Recording Studio Repair and Maintenance

Hands-on experience in repair and maintenance techniques. Common minor repairs and routine maintenance of recording equipment; test equipment and tools;

power supplies, op-amps, and low-noise amplifiers; distortion; analog and digital hardware; and interface considerations. Permission of Coordinator and Chair. 3 credit hours.

78.490 Seminar in SRT Technical Research

An open forum is created for students to undertake research projects of a technical nature and that are directly related to SRT. The course will require constant class participation through discussion of research findings and techniques on projects related to audio equipment and applications; theories of operation and design, human interfacing considerations, hardware and software development, enhancing creative flexibility in sound synthesis and recording production. Permission of Coordinator and Chair. 3 credit hours.

78.492 Internship Preparation

Defining internship objectives, researching potential internship location, preparing to solicit internship, contacting potential sites, and interviewing for and securing the internship. Permission of Coordinator and Chair. 2 credit hours.

78.493 Internship Residency

Practical experience in audio-recording under the supervision of a professional firm. At least twenty hours per week for fifteen weeks is spent working at an entry-level position for a firm involved in audio production. Permission of Coordinator and Chair. 4 credit hours.

78.494 Recording Technology Senior Project

Advanced projects developed in consultation with faculty advisor. Typical projects include production of a complete record album, investigation of experimental recording techniques, and original research in recording technology. To be completed in place of 78.493 by students not choosing an internship. Permission of Coordinator and Chair. 6 credit hours.

78.495 Directed Study in Sound Recording Technology

Individual work under the supervision of a member of the SRT faculty on a topic or area of production approved by the instructor and the Coordinator of SRT. Permission of Coordinator and Chair. 3 credit hours.

Department of Philosophy

Robert E. Innis, Chairperson

Professors: Robert E. Innis, R. Eugene Mellican, Arthur I. Miller (Emeritus), P. Christopher Smith

Associate Professors: Robert B. Wagner

Assistant Professors: Noëlle McAfee, Jane Freimiller

Department Location: Olney Hall, Room 102

Telephone: (978) 934-2528

The Philosophy program through its emphasis on critique (its role as a Socratic gadfly) and on the examination of the twin fundamental issues of human life, meaning and action, links the arts, the sciences, and the humanities. It occupies an integral and essential place in both the College of Arts and Sciences and the University. The Philosophy program illustrates through specific courses how philosophical ideas have influenced other disciplines and how it has been illuminated by the intellectual visions expressed through those disciplines. Serious contact with the discipline of philosophy sharpens critical thinking, clarifies values, and helps to produce articulate, intellectually prepared, and adaptable individuals ready to lead contemporary society in a socially responsible manner.

The Philosophy Department has structured its course offerings so that they appeal to majors and non-majors alike: courses intersect with issues and problems treated in other disciplines, from the natural sciences through engineering to the social sciences and the other humanities. The Department especially shows the interrelationships between different areas of knowledge and also between different areas of existence, both individual and social. It aims to counteract the fragmentation of knowledge that is a mark of modernity. Consequently, the Philosophy courses are designed to appeal to the broadest range of students and to continue philosophy's traditional role as an indispensable integrator in the University curriculum.

The Department of Philosophy offers a major in Philosophy which leads to the

Bachelor of Arts degree. The Department also offers a minor in Philosophy.

Philosophy Major

The Philosophy major is designed to serve the needs of three types of students: 1) those who seek a liberal arts education as a terminal program; 2) those who are preparing for professional graduate schools, e.g., education, law, theology, and medical schools which approve an undergraduate philosophy major; and 3) those who are preparing for graduate work in philosophy. A Philosophy major is of value to all who question the reasons for things as they are, to those who seek a deeper understanding of what they are doing and their purpose for doing it, and to those who recognize the validity of Socrates' assertion that the "unexamined life is not worth living."

A major in Philosophy consists of 30-45 credits (with at least 15 credits at the 300 level or above). The Department does not specify particular course work for the major but recommends that the sequence of courses be designed in close consultation with the student's faculty advisor. Students who plan to go to graduate school are strongly encouraged to take at least two courses from the History of Philosophy series, 45.285 to 45.288, including 45.350. They should also consider a second major in a cognate field, e.g., American Studies, English, French, History, Mathematics, or Political Science.

Communications and Critical Thinking Option

The Philosophy Department also offers an interdisciplinary option in "Communications and Critical Thinking" within the Philosophy major, leading to the Bachelor of Arts degree. This program serves students looking to increase their professional options within such fields as publishing, public relations, advertising, sales and marketing, and social services, and who want an interdisciplinary course of study that transcends the confines of traditional programs. The program also provides excellent preparation for further graduate study, above all, in law and business.

Students transferring into the College who wish to major in Philosophy must make individual arrangements with the chairperson of the Department of Philosophy regarding satisfaction of major course requirements.

Philosophy Minor

A minor area of study consists of 18-24 credits of coursework in Philosophy. At least six credits must be selected from courses which are numbered 300 or above.

General Requirements

For students entering the University in Fall 1999 and subsequently

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics**(Gen Ed)	3
45.	Philosophy Elective	3
	General Education Course**	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	General Education Course***	3
	General Education Course***	3
45.	Philosophy Elective	3
	Beginning Language II	3
		15

Sophomore Year

Fall Semester

45.	Philosophy Elective	3
45.	Philosophy Elective	3
	General Education Course***	3
	General Education Course***	3
	Intermediate Language I	3
		15

Spring Semester

45.	Philosophy Elective	3
45.	Philosophy Elective	3
	(300 level or above)	3

General Education Course***3

General Education Course***3

Intermediate Language II 3
15**Junior Year****Fall Semester**

45. Philosophy Elective
(300 level or above) 3

45. Philosophy Elective
(300 level or above) 3

General Education Course***3

General Education Course***3

Free Elective 3
15

Spring Semester

45. Philosophy Elective
(300 level or above) 3

45. Philosophy Elective
(300 level or above) 3

Philosophy or Free Elective 3

Free Elective 3

Free Elective 3
15

Senior Year**Fall Semester**

Philosophy or Free Elective 3

Philosophy or Free Elective 3

Free Elective 3

Free Elective 3

Free Elective 3
15

Spring Semester

Philosophy or Free Elective 3

Philosophy or Free Elective 3

Free Elective 3

Free Elective 3

Free Elective 3
15

*36 credits are recommended for students
planning to attend graduate school

**Refer to the Academic Policies section
of this catalogue for General Education
requirements in mathematics

***The remaining General Education
requirements include: two courses in
Behavior and Social Studies, one course in
Historical Studies, one course in
Literature, one course in Values, Concepts
and Choice, one course in Aesthetics and
three courses in the Sciences, two of
which must include some form of experi-
mental learning such as a laboratory.
Consult the Academic Policies section of
this catalogue for approved lists of
General Education courses.

**Communications & Critical Thinking
Option**

A Philosophy major with a
Communications & Critical Thinking
Option consists of 30-36* credits. The
department does not specify course work
for the major but recommends that the
sequence of courses be designed in close
consultation with the student's faculty
advisor.

The option in Communications & Critical
Thinking is designed to serve the needs of
three types of students:

- 1.) those who seek an interdisciplinary
course of study that transcends the
confines of traditional programs;
- 2.) those who are looking to increase
their professional options within such
fields as publishing, public relations,
advertising, sales and marketing, and
social services;
- 3.) those who are preparing for further
graduate study especially in business
and law.

Freshman Year**Fall Semester**

42.101 College Writing I (Gen Ed) 3

92. Mathematics (Gen Ed) 3

45.203 Intro. to Ethics** 3

Historical Studies (Gen Ed) 3

Beginning Language I 3
15

Spring Semester

42.102 College Writing II (Gen Ed) 3

91.113 Exploring the Internet 3

Beh & Soc St (Gen Ed) 3

45.202 Intro to Logic & Crit Reason**3

Beginning Language II 3
15

Sophomore Year**Fall Semester**

Group A Elective (Crit. Theory)3

Group B Elective (Pract Appl.)3

Science w/lab (Gen Ed) 3/4

Beh & Soc St (Gen Ed) 3

Intermediate Language I 3
15/16

Spring Semester

Group A Elective 3

Group B Elective 3

Science w/lab (Gen Ed) 3/4

Literature (Gen Ed) 3

Intermediate Language II 3
15/16

Junior Year**Fall Semester**

Group A Elective 3

Group B Elective 3

Free Elective*** 3

Values, C & C (Gen Ed) 3

Minor Elective 3
15

Spring Semester

Group A Elective 3

Free Elective 3

Free Elective*** 3

Aesthetics (Gen Ed) 3

Minor Elective 3
15

Senior Year**Fall Semester**

Group A Elective 3

Practicum Exper/Dir BA Thesis 3

Free Elective 3

Minor Elective 3

300/400 level Minor Elective	3
	15
Spring Semester	
Free Elective	3
Group A or B Elective	3
Free Elective	3
300/400 level Minor Elective	3
Minor Elective	3
	15

*36 credits are recommended in order to be eligible for graduate school.

**Strongly recommended, but not required.

***It is recommended that students continue with foreign language studies through advanced level.

Required courses—2 courses from the group comprising:

- 45.201 Introduction to Philosophy
- 45.202 Introduction to Logic and Critical Reasoning
- 45.203 Introduction to Ethics
- 45.206 Introduction to Political Philosophy

Approved Elective Courses for Groups A and B

Group A (Critical Theory) Electives—choose at least 5, 3 of which must be listed under the 45 (Philosophy) rubric.

- 45.354 Classical Rhetoric & the Theory of Argument,
- 45.305 Language, Signs, & Symbols,
- 45.301 Theory of Knowledge,
- 47.365 The Psychology of Language,
- 45.309 Logic & Language,
- 50.315 Cultural Intro to the Languages of Europe,
- 42.307 History & Dev. of English,
- 42.308 Analysis of Modern English,
- 45.325 Critical Thought: Hegel, Marx, Marcuse,
- 42.429 Critical Theory & Interpretation,
- 45.343 Hermeneutics & Deconstruction,
- 45.384 Philosophies of Art & Beauty,
- 46.316 or 45.316 Politics, Philosophy and Film,
- 74.419 Theory & History of the Performing Arts,

- 78.301 Music, Tech., & Soc.,
- 45.335 Ethical issues in Tech.,
- 45.329 Environmental Ethics,
- 48.260 Sociology of Mass Media.

Group B (Practical Application) Electives - choose at least 3

- Applications of New Technology, Communication Needs Intersect with Cybertexts,
- 42.391 Business Communication,
- 42.229 Essay Writing,
- 59.316 Uses of Multimedia,
- 42.300 Journalism,
- 42.387 Editing & Publishing, Theory & Practice of Camera Vision, Computer Graphics & Visual Communication by Design,
- 42.261/262 Acting/Advanced Acting.

Philosophy Courses (Prefix: 45)

45.201 Introduction to Philosophy
An examination of some of the typical approaches to philosophical questioning and the issues raised in such inquiry: what is knowledge, what is the good, what is the right political order, what is the nature of religious faith? 3 cr

45.202 Introduction to Logic
Designed to study the methods used to distinguish correct from incorrect argument. It aims at developing (1) an ability to express one's ideas clearly and concisely, (2) an increased skill in defining one's terms, and (3) a capacity to formulate arguments vigorously and to scrutinize them critically. 3 cr

45.203 Introduction to Ethics
An examination of the basic issues and problems of ethics and value and a survey of some important traditional and alternative answers to the questions raised, on both an individual and a social level, by our necessity to act and to live in a rational and human way. 3 cr

45.206 Introduction to Political Philosophy
Political philosophy addresses questions such as these: What brings us together in political community? What kind of institutions should govern our common concerns? What, if anything, is the basis for obeying these institutions? Do we come together to protect our personal freedoms

or out of allegiance to some common good? In addressing such questions, political philosophy attempts to create the most justifiable basis for how we might organize ourselves politically. Students will read some of the major works in political philosophy, including Aristotle's *Politics*, Locke's *Second Treatise on Government*, and other classic texts. We will conclude with an examination of the tensions at work today in political thought surrounding the end of the Cold War and the rise of nationalist civil wars. 3cr

45.285 Ancient Philosophy
A survey of the beginnings of philosophy, mainly western, from the Presocratics to Augustine. Studies the emergence of philosophy out of mythical forms of thinking and the development of rational thought in the work of Plato, Aristotle, the Stoics, the Epicureans, and the Neoplatonists. 3cr

45.286 Medieval Philosophy
A survey of the transformation and development of classical philosophy from the time of Augustine (5th century) to the breakdown of the medieval worldviews in the 14th and 15th centuries. The three great post-classical traditions of Christianity, Islam, and Judaism will be studied with respect to the encounter between revealed religion and the claims of autonomous reason. 3 cr

45.287 Modern Philosophy
A survey of the development of philosophy from the 16th century to the end of 18th century. Special attention will be given to the attempt to put philosophy on an autonomous and unassailable foundation with Descartes, to the conflicts between rationalist and empiricist tendencies in the work of the major thinkers such as Hobbes, Locke, Berkeley, Spinoza, Leibniz, and Hume, and to the continuing tensions between the demands of the new concept of science and the cognitive claims of philosophy. 3cr

45.288 19th and 20th Century Philosophy
A survey of the development of philosophy from the Kantian/ĒCopernican Revolution to the present. Of special concern will be the transformations in the conception of philosophy's tasks in the work of the great post-Kantian thinkers such as Hegel, Marx, Kierkegaard, and Nietzsche and the challenges to traditional

philosophy issued by pragmatism, phenomenology, and the analytic philosophy of Wittgenstein. 3cr

45.296 The Religious Experience of Mankind

A study of religious knowledge and the phenomena of religion from a philosophical standpoint. The course considers explanations for religious behavior, some central issues in religious belief, and the values and goals of religious systems. Various world religions provide specific data for these topics. 3 cr

45.300 Philosophy and Society

An examination of the shifting nature of the chief material, symbolic, and normative premises of social, historical, and cultural processes. The course studies the interactions and intersections between the various formations in which human life objectifies itself, and investigates the tensions and distortions to which they are subject. 3 cr

45.301 Ways of Knowing

Studies and analyzes various forms and expressions of human knowledge (perception, concept-formation and symbolic functioning, myth, aesthetic creation and interpretation, scientific discovery and understanding) and the individual, social, and historical conditions to which they are subject. The goal of the course is a comprehensive view of the structure of the human mind and its operations. 3 cr

45.302 Theories of Democracy

This course will provide an advanced survey of ancient, modern, and contemporary theories of democracy from Pericles' Funeral Oration to contemporary attempts to have democracy truly emanate from the will of the people. We will study several strands of democratic thought: the civic republican approach with its roots in Aristotle and Cicero and its contemporary variant in communitarianism; the liberal approach which is grounded in John Locke's social contract theory and is represented today by John Rawls' work; "radical democratic" theory with its roots in Marx and Gramsci; participatory democracy which sprang from the civil rights movement; and, most recently, deliberative democratic theory. 3cr

45.303 Philosophy and Technology

A philosophically oriented, systematic

examination of the chief aspects of material, economic, political, cultural, aesthetic, ethical of the processes by which the human race creates and embodies itself in tools and instruments. 3 cr

45.304 God and Philosophy

Studies, historically and systematically, the following topics: a) the origin and content of the idea of God, b) the possibility of affirming God, philosophically and religiously, c) the complex nature of religious language and imagery, and d) God's relation to the world, history, and the individual. 3 cr

45.305 Language, Signs and Symbols

An examination of the various grammars of human expressions from the point of view of a general theory of signs. Among the topics to be treated are: a) the nature of signs, symbols, and meaning; b) the structures and functions of language; c) the relations between language, thought, and reality, especially as manifested in metaphor; d) the social dimensions of signification and symbolization; and e) the relations between the different linguistic, sign, and symbol systems. 3 cr

45.306 Feminist Theory and Politics

Feminist theory has always had a political agenda: to improve the situation of women in society. But it also has philosophical import, asking basic questions about personal identity, about ethical obligations to others, about knowledge, and about the history of philosophy. This course will bring together both of these strands, focusing on feminist theory, feminist politics, and the contributions that feminist theory can make in thinking about politics in general. The course asks, what could feminist theory offer not only women but all of society? Course material covers various feminist orientations, including classical liberal feminism, cultural feminism, French feminism, and recent contributions to democratic theory. 3cr

45.308 Philosophy of Race and Gender

This course will focus on issues of identity and difference. We will discuss the ways in which group identities are formed and break down. We will discuss how differences are constituted and reconstituted. These issues are central to theories of race and gender, racism and sexism. Some of the questions which we will raise are

these: What motivates forming group identities? How are they formed? How is identity used within oppressive social structures? How can it be used to transform society? Why do some differences make a difference and others don't? Can we choose our group identities? 3cr

45.309 Plato on Logic and Language

We will read closely and discuss two of Plato's most important late dialogues, *Theaetetus*, and *Sophist*, and refer briefly to other dialogues as we go along. We will, of course, focus on what these dialogues tell us about logic and language, but this focus will not prevent us from treating the dialogues' magnificent themes, what is true, what is good, what is beautiful. On the contrary, our focus on logic and language will open the path to consideration of precisely these things. 3cr

45.310 Philosophy of the Creative Imagination

Focuses first on imagination as a function of mind, placing it in relation to other functions such as perception, emotion, and conceptualization. Attention is then given to the difference between the reproductive and the creative imagination, with special emphasis on the psychological and social/political dimensions of creativity. Topics to be considered include poetical metaphor, theatrical performance, painting, architecture, or photography. 3 cr

45.311 Philosophy and Literature

This course will explore various philosophical themes through literary and philosophical writings. We will discuss philosophical issues such as the relationship between individuals and society, knowledge and truth, ethics, personal identity, and oppression. In the process of using both philosophical and literary texts to address these issues, we will examine the distinction between philosophy and literature. Rather than try to survey all major philosophical themes and approaches, this course will select a few particularly salient texts and their interconnections. 3cr

45.312 Philosophy of Science

Explores ways in which science has been understood in different historical periods. An investigation is made of the kinds of propositions which are strictly scientific; the methods which are appropriate to scientific inquiry; and the nature, origins, and

cultural implications of scientific revolutions. In addition, attention is given to certain key concepts (e.g., space, time, causality) which have played a central role in the history of science in order to correlate changes in these concepts with developments undergone by the notion of science as such. 3 cr

45.314 Philosophy and Science Fiction

This course is an exploration and analysis of the philosophical issues embedded in science fiction literature, film, and television shows. The philosophical themes addressed are: the nature of time, causality, minds, personal identity, ethics, and the meaning of life. 3 cr

45.315/324 Philosophical Classics

A close study of some of the great texts of philosophical literature. In general, one or two major works are selected and subjected to a thorough reading. 3 cr

45.316 Politics, Philosophy, and Film

This course examines the political and philosophical values and ideas which constitute cinema. It analyzes film as an historical, cultural, commercial, and artistic endeavor. Students will develop the skills to watch film actively and critically. 3 cr

45.325 Critical Thought: Hegel, Marx, Marcuse

In pursuing critical thought the course will consider extrangement, alienation and dehumanization as these result from the commercialization of human relationships. Using Marcuse's *Reason and Revolution*, we will clarify the meaning of critical, dialectical, negative thinking. We will turn next to Hegel's exposition in his *Phenomenology of Spirit* of consciousness of self as this develops through meaningful work. With recourse again to Marcuse's *Reason and Revolution*, we will apply the writings of the early Marx to understand how this development of consciousness to self-awareness is reversed when work becomes making money in one's own self-interest. At issue throughout will be what remains of critical thought in a Hegelian, Marxian sense once Hegel's and Marx's claim to absolute reason and knowledge has been destroyed (by Heidegger and others), and the limits of human understanding are acknowledged. 3 cr

45.329 Environmental Ethics

This course examines environmentalism

as a subdiscipline of philosophy, a mode of analysis, and a way of life. It examines ethical theories including Deep Ecology and Ecofeminism, the interrelationships between environmental ethics and other disciplines, and explores the ethical components of different varieties of activism. 3 cr

45.330 Philosophy of Symbolic Logic

The first half of this course examines various axiomatic systems, and the student develops both intrasystematic and meta-systematic techniques of proof. During the second half of the course, attention is given to certain important philosophical problems which arise from reflection on logical systems, e.g., the cognitive processes of abstraction and instantiation, the general notion of form, and questions of consistency and interpretation. 3 cr

45.331 Philosophy of Mind

The status of consciousness is the central concern of a philosophy of mind. The course takes as its point of departure a reflection upon the nature and significance of consciousness from the perspective of its advocates (Husserl, Sartre) and its adversaries (Ryle, Skinner). The results of this preliminary inquiry is to provide a foundation for the exploration of other issues: the possibility of an unconscious; the temptation of bad faith; the dynamics of concept formation; and the nature of emotion, imagination, and dreams. 3 cr

45.332 Cognitive Sources of Conflict

A study of the perceptual and cognitive biases as causes of conflict. Among the topics to be examined are: sources and mechanisms of personal bias; theories of the sociology of knowledge, cognitive dissonance, doubling, and prejudice; and implications for critical thought. 3 cr

45.333 Symbols and Society

The central task is the philosophical examination of a variety of social symbols (verbal, visual, and praxic) in terms of their relations to modes of social control or influence and to perceptions of social realities. This inquiry is carried out by exploring the dynamics of social symbols in traditional non-literate societies as well as in literate technological societies, in order to understand how people both affect and are affected by the symbol systems among which they live their lives. Topics to be considered include myth,

folklore, painting, photography, advertising, and propaganda. 3 cr

45.334 Engineering and Ethics

A philosophical analysis of the ethical dimensions and responsibilities of the engineering profession. Specific case studies and ethical issues are analyzed through the application of some of the basic concepts and principles of traditional and contemporary ethical theories. 3 cr

45.340 Mysticism: East and West

This course explores the similarities and differences in the mystical traditions of various world religions. The course develops a working definition of mysticism, discusses the philosophical problems of examining nonrational experience, and traces various motifs (Eros, journeys, dissolution of the ego, etc.). The course also looks at the relation of mystical experience to organized religion. 3 cr

45.341 Science, Ethics, and Society

The ethical problems and issues (personal, social, political, medical, environmental) attendant upon the rise of science and scientific rationality and their pre-eminent place in society. 3 cr

45.342 Critical Theory of Society

The mature and methods of a critique of society that focuses on the conflicts between the various modes of rationality and rationalization. 3 cr

45.343 Heidegger & Deconstruction

This course will treat Heidegger's book *Being and Time* with particular attention to its description of authentic/inauthentic human existence, "there" in the world, and always subject to the Angst or anxiety of having to decide how it will live its life. We will see, however, that for Heidegger human existence is just one example of being which has no logical structure behind it and whose exposition first requires the destruction of any such structures. Derrida's essay "Plato's Pharmacy" will show us how this strategy of "deconstruction" can be applied in interpreting other beings, specifically, a written text, Plato's *Phaedrus* dialogue. 3 cr

45.344 The Idea of Nature

The changing contents and the changing epistemological, social, aesthetic, economic, and religious implications of the concept of nature. 3 cr

45.350 World Philosophies

This course will fuse the historical and the thematic approaches in order to undertake a comparative examination of the relations of the great philosophical traditions (Chinese, Indian, Western, Islamic, and Japanese) to the perennial issues of philosophy. The main focus will be the continuing vitality and heuristic fertility of these traditions and their ability to define how human beings are situated in the order of things and how in light of their ordinal placement in nature they are to interpret themselves and conduct their lives. 3 cr

45.354 Classical Rhetoric and the Theory of Argumentation

Recent insights into the limits of traditional logic have confirmed that Aristotle was correct when, in distinguishing between the logical syllogism and the rhetorical enthymeme, he implied that in any field of argument outside the pure mathematical sciences there are no certain starting points and no final conclusions and, accordingly, the more useful model would be public speech and discussion, not inference and deduction. In examining the texts of the ancient masters of rhetoric, Aristotle, Cicero, and Quintilian, this course takes up their reflections on the nature of effective argument—epideictic, and deliberative—and thereby attempts to lay bare the foundations of contemporary rhetorical theories. 3 cr

45.355 Language in Homer, Sophocles, and Plato

Starting with the narrative epic of Homer's *Iliad* and *Odyssey*, continuing with the tragic drama of Sophocles's *Antigone*, and concluding with the written dialogue of Plato's *Phaedo*, the course will consider the changes in the understanding of language as it develops from speech that is heard to writing that is read. In assessing the transition from orality to literacy we will draw upon the commentary of Havelock, Ong, Perry and Nagy. 3 cr

45.356 The History, Theory, and Practice of Rhetoric

The course will use interactive television between UMass Lowell (origin) and UMass Boston (destination). Students will learn not only what the great rhetors from Demosthenes, Cicero, Quintilian to Lincoln, Churchill and M.L. King can teach

us about effective oral presentation, but also how to apply what they learn by practicing with the leading edge broadcast communications technologies available in our class room. Both written examination papers and short presentations will be required. (This course can be counted for either the Group A or Group B requirement in the C&CT track in philosophy at UML.) 3 cr

45.357 Science and Religion

A study of the multiple relations between science and religion focussing on the theme of creativity. The problem of the various truth claims of the two systems will be subjected to a close analysis and principles developed to understand how conflicts between the them can be understood and resolved. 3 cr

45.358 Alternative Ethical Theories: Continental

This course will explore Continental (that is, European) alternatives to traditional (deontological and utilitarian) ethics. We will focus on four major figures, in this order: Luce Irigaray (drawing on Hegel's reading of "Antigone"), Emmanuel Levinas, Julia Kristeva and Jürgen Habermas. Instead of asking the question, "Why be moral?"—as if we might avoid any ethical relation with others—these continental philosophers tend to see the human condition as already in relation with others. Moreover, some Continental approaches tend to see our ethical relations as constitutive of our identities. Other Continental approaches, namely Habermas's, try to develop alternative principles of universalizability in order to revive Enlightenment ideals of rationality. To close the course, we will also investigate how these approaches lend themselves to new understandings of community. 3 cr

45.384 Philosophies of Art and Beauty

Examines the views of major philosophers on the beautiful and the nature of artistic creativity. An attempt is made to correlate the views of the thinkers with the works of poets, artists, and composers and the statements the latter have made about their work. 3 cr

Directed Studies

Directed studies courses are available only to majors in Philosophy and may be elected provided that 1) the material to be covered is not available in any course offered during the semester in which a directed studies course is contemplated, 2) instructors are willing to undertake a directed studies course, and 3) no more than nine hours of credit in the major field is acquired through registration for and completion of directed studies courses.

45.491 Directed Study in Philosophy

The student, through regular and frequent consultation with an instructor, pursues a special problem in philosophy, the results of which are presented in a 25-30 page paper. Prerequisite: permission of instructor. 3 cr

45.495 Advanced Tutorial in Philosophy

A program of directed study which provides the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of instructor. 3 cr

Department of Physics and Applied Physics

Dr. James J. Egan, Chairperson

Dr. Arthur Mittler, Undergraduate Coordinator

Dr. Lloyd Kannenberg, Graduate Coordinator

Professors: Albert Altman, Adolph Baker (Emeritus), Leon E. Beghian (Emeritus), George L. Carr (Emeritus), George E. Chabot, Gus P. Couchell, James J. Egan, Zoltan Fried, William D. Goodhue, F. Raymond Hardy (Emeritus), Padmanabh Harihar, Jesse Harris (Emeritus), Lloyd Kannenberg, Aram S. Karakashian, Gunter H.R. Kegel, Jayant Kumar, David M. Larsen, Anthony Liuzzi (Emeritus), Suresh C. Mathur (Emeritus), Arthur Mittler, David J. Pullen, Walter A. Schier, Kunnat Sebastian, Eric Sheldon (Emeritus), Kenneth W. Skrable (Emeritus), Malcolm K. Smith (Emeritus), Richard W. Stimets, Jerry Waldman, Martin Wilner, Francis Worrell (Emeritus)

Associate Professors: Partha Chowdhury, Clayton S. French Jr., Thomas V. Marcella (Emeritus), Roger D. McLeod, Walter K. Mellen (Emeritus), Paul J. Ring (Emeritus), Alexander Sachs, Chuen Wong

Department Location: Olney Hall, Room 136

Telephone: (978) 934-3750

The Bachelor of Science (B.S.) degree offered in Physics is intended to prepare a student for a career in industry, teaching, or graduate study in a number of fields by providing him/her with a flexible course of study which superimposes a specialization chosen by the student (at least 13 credits of technical electives) on a general physics foundation (47 credits of required courses in the Kernel). At least 53 credits total must be taken in physics courses to satisfy the requirements for the B.S. in Physics. Some of the technical electives may be chosen from appropriate courses outside the Department or from the list of Physics Elective courses. There are five courses of study available: Standard, Optics Option, Radiological Health Physics Option, preparation for Graduate School, and preparation for teaching. Successful completion of either option

program will be certified by the Department on the student's transcript.

The Bachelor of Science in Physics

Physics is the science of matter and is concerned with its fundamental structure, properties and behavior. The fields of chemistry, biology, geology, astronomy and engineering, among others, draw upon physics for their basic understanding.

A present day physicist engages in research, development and design, teaching or administration. The employer may be an educational institution, a small business, a large industrial firm, a government laboratory or a non-profit research center. Those physicists who obtain a doctorate (Ph.D.) are prepared for a research career and are expected to have a high level of initiative with responsibility for a research program. This program can fall anywhere in the range from "basic" through "applied" depending upon one's interests and those of his/her employer. The physics program is designed to give the student a continuum of career choices.

Accordingly, the University of Massachusetts Lowell program can prepare students for a research career. The required and elective courses develop a sound understanding of the principles of experimental and theoretical physics and can successfully prepare the physics major for graduate study. The program also accommodates students who will seek employment after receiving the Baccalaureate degree. It allows these students to develop a remunerable talent in some specialized field. This is possible because of the number of technical electives in the curriculum. Through these electives the student acquires at least 13 credits in some field of specialization.

The program is very flexible allowing the student to match his/her special interests with the study of physics. Specialties may be as far afield as economics or management or as close as mathematics or chemistry. They may be in any of the engineering fields or computer science. A student pursuing this course of study develops a solid foundation in physics and concurrently acquires a good background in a specialized field thereby obtaining the nec-

essary practical knowledge to solve applied problems competently.

This combination of the general and the specialization prepares the student for immediate employment after graduation. Some graduates of this program have chosen industry, government work, or teaching. While such business employment may be the primary goal of the student, it is also possible to pursue graduate studies in either the specialized field or physics.

Students who complete the undergraduate program in physics often receive awards for complete support for graduate study. In the past, graduating seniors have received awards of complete tuition for graduate study and additional stipends from graduate schools such as Harvard University, the University of Chicago, Brown University, the University of Illinois, Johns Hopkins University, Brandeis University, Purdue University, the State University of New York at Stony Brook, Boston University, the University of Maryland, Rochester University, University of Arizona and Rensselaer Polytechnic Institute.

Optics Option

Majors in the Department of Physics and Applied Physics may also elect an Optics Option which will be recognized on the student's transcript providing an official declaration form is filed at the end of the lower division program. This option will provide the student with intensive training in optics in preparation for immediate entry into a career in one of the many rapidly expanding fields in optics such as optical component and system design, lasers, and image processing. In addition, students wishing to continue their training will be qualified to enter graduate study in physics, optics, astronomy or engineering.

This option has been developed by the Department of Physics and Applied Physics in consultation with an Industrial Advisory Panel of distinguished physicists active in various fields of optics in order to fill a need in the New England area for graduates at the B.S. level with a strong background in optics. Students enrolled in the Optics Option will have an excellent chance of finding summer or part-time employment in the optics industry during their junior and senior years.

The topics which will be covered in the courses offered under the Optics Option include the basic principles of geometrical optics and their application to the design of optical components and systems such as lenses, microscopes and telescopes, the design and operation of optical devices such as lasers, spectrometers and interferometers, the generation and detection of various types of electromagnetic radiation, optical properties of materials and the properties of imaging systems and image processing. There will be extensive laboratory work associated with the courses utilizing state-of-the-art equipment.

Radiological Health Physics Option

Radiological health physics involves the study of the effects of radiation and radioactivity on life processes. It also can be called radiation protection science and is particularly involved with the effects of radiation on the human body and the control of such radiation.

A graduate of this curriculum would enter the profession of health physics, which is devoted to the protection of human beings and their environment from radiation hazards, while at the same time making it possible for our advancing civilization to enjoy all of the benefits resulting from uses of radiation.

Radiation control in its professional aspects incorporates an understanding of many disciplines. It has common scientific interests with many areas of specialization: biophysics, physics, biochemistry, chemistry, biology, genetics, ecology, nuclear engineering, metallurgy, medicine, physiology, and toxicology. Other aspects of the profession include working knowledge of labor relations, public relations, teaching, philosophy, and administration. The wide spectrum of knowledge required of the health physicist makes this profession both challenging and rewarding.

Health physicists are employed by federal agencies (such as the Nuclear Regulatory Commission and Department of Energy) at research, production, and testing facilities; state, and local government agencies responsible for regulating the use of radioactive materials; the military services; electric utilities operating nuclear power plants; businesses which use radioisotopes or x-ray equipment to detect

flaws or defects in manufactured products, prepare or reprocess nuclear fuels, control nuclear wastes, or produce or use radioactive materials or devices; universities (in teaching, research, and equipment monitoring); hospitals and medical centers that use radionuclides, x-ray equipment, and accelerators in the diagnosis and treatment of patients; and consulting firms which advise the service installations that do not employ full-time health physicists.

Scholarships are available for undergraduate students who choose the Radiological Health Physics Option. These are available from the Nuclear Regulatory Commission, the Department of Energy, the Health Physics Society, the National Academy for Nuclear Training, and other organizations concerned with radiation protection. All students in the Radiological Health Physics Option who have completed the required sophomore year courses currently receive a \$500 scholarship from funds donated by Northeast Utilities Service Company of Hartford, Connecticut. These scholarships have been sponsored to attract highly qualified young men and women into the much needed field of radiation protection sciences.

The Radiological Health Physics students enjoy excellent job opportunities and challenging careers in the radiation protection field upon graduation. Students may gain valuable applied work experience while also earning much needed money through various summer internship programs at the University of Massachusetts Lowell. They also may gain experience and academic credit through an internship course at the University Radiation Laboratory. This course is conducted under the direction of the health physics staff who have responsibility for the radiation safety programs at the nuclear reactor facility, accelerator facility, radioisotope research laboratories and x-ray facilities at the University of Massachusetts Lowell. The academic and job experience that the students receive provide excellent preparation for either an applied health physics position or the pursuit of an advanced degree in radiation protection or related fields. The University of Massachusetts Lowell offers, as well as the B.S. program, both M.S. and Ph.D. programs in radiological sciences and protection and receives research and scholarship support from

government and industry. Radiological Health Physics graduates at all degree levels are receiving many high-salaried job opportunities.

Five-year B.S./M.S. Program in Radiological Sciences

In recognition of the need for advanced training beyond the bachelor of science level in radiological sciences, the following represents a program by which outstanding undergraduates can pursue an accelerated five-year course of study leading to the B.S. and M.S. degrees in Radiological Sciences.

1. Undergraduate students who express an interest in this program will be evaluated by the graduate selection committee. Those students deemed commendable by the committee will be advised relative to the correct procedure for successful completion of their B.S. degree, as well as a course of study toward the M.S. degree.
2. The first three years of undergraduate study will be identical to that which is specified for students enrolled in the current four year B.S. program.
3. During the second semester of the junior year and upon approval and recommendation by the graduate selection committee, the student will file formal application to the Graduate School. This does not require the student to have taken the Graduate Record Examination. The committee decision will be based on; a) overall grade-point average, b) grade-point average in selected subjects, c) recommendations by program faculty, and d) a one year minimum residency requirement at the University of Massachusetts Lowell. Upon approval and recommendation by the Dean of the Graduate School, the student may be allowed to pursue graduate studies during the Senior year and officially become a provisional graduate student in the first semester of senior year.
4. During the senior year, the student will be permitted to take up to four graduate-level courses which can be applied towards the M.S. degree. Although advanced undergraduate (i.e., 400 level) courses are acceptable, no more than two such courses will be allowed towards the M.S. degree. It should be emphasized that the total number of credits for the com-

bined degrees must be greater than the minimum number of credits required for both the undergraduate and graduate degrees. The University B.S. requirement is 120 credits, thus a student with a total of 124 credits may, with approval, transfer up to four of the credits used to obtain the B.S. degree toward the M.S. degree.

A maximum of 12 credits can be transferred toward the M.S. degree program.

5. Upon completion of the fourth year of study, assuming that all program and University requirements have been met, the student will be awarded the B.S. degree and may then be recommended for full matriculation status by the graduate selection committee and the Dean of the Graduate School prior to the fifth year of study. If the student chooses not to continue toward the M.S. degree (or fails the fifth year), this does not alter receipt of the B.S. degree.

6. Although the options exist for taking an overload in any semester and/or registration for one or more summer sessions, they are not a requirement of this program. However, students wishing to gain a full research experience will be encouraged to initiate their research as early as possible (e.g., during the junior to senior year summer session), which is a distinct advantage of this accelerated program.

7. During the fifth year, as in the standard M.S. degree program, the student may undertake: a) thesis option (nine semester hours of graduate research) or b) project option (three semester hours of graduate project). In either case, the student will be required to take two one-credit graduate seminar courses, as well as the other courses required for the M.S. degree in radiological sciences, and must satisfy the 30 credit minimum M.S. degree requirement. Upon completion of all program and graduate school requirements, the student will be awarded the M.S. degree.

Kernel Program

The courses listed below constitute the required Kernel for all physics majors. Sample programs of study are shown in the next section which illustrate how these courses can be integrated with General Education requirements and Physics Electives to make a four-year degree program.

I. Lower Division Courses

95.112	Fresh Phys Sem	1 cr
95.161	Physics I (H)	4 cr
95.164	Physics II (H)	4 cr
95.269	Physics III (H)	4 cr
96.161	Physics I Lab (H)	2 cr
96.164	Physics II Lab (H)	2 cr
95.210	Intro Modern Physics	3 cr
96.260	Physical Instrumentation	2 cr
96.295	Interm Exper Phys	2 cr

Non-Physics

42.101	College Writing I	3 cr
42.102	College Writing II	3 cr
84.121	Chemistry I	3 cr
84.122	Chemistry II	3 cr
84.123	Chemistry I/II Lab	1 cr
84.124	Chemistry II Lab	1 cr
92.131	Calculus I	4 cr
92.132	Calculus II	4 cr
92.231	Calculus III	4 cr
92.234	Differential Equations	3 cr

II. Upper Division Courses*

95.310	Quantum Physics	3 cr
95.338	Optics and Waves	3 cr
95.353	Elect - Magn I	3 cr
96.393	Adv Exper Phys I	2 cr
96.394	Adv Exper Phys II	2 cr
95.411	Sen Phys Sem	1 cr
95.413	Mechanics	3 cr
95.421	Statistical Thermo	3 cr
95.452	Contemporary Physics	3 cr

Non-Physics

92.301	Applied Math I	3 cr
92.302	Applied Math II	3 cr

Any waivers or substitutions for these requirements must be approved by the Undergraduate Coordinator.

*Upon completion of the Lower Division courses (Freshman and Sophomore Level)

the students' records will be reviewed by a committee of at least three faculty members. A recommendation will be made to proceed to Upper Division courses (Junior and Senior Level) or to take remedial courses or repeat courses as deemed necessary to prepare the student for the Upper Division courses. A revised program will be formulated for each student requiring remedial work which may extend his/her program by one or more semesters. In appropriate cases the student will be advised to change major. The student attains the status of physics baccalaureate degree candidate when admitted to the Upper Division.

Non-Physics Electives and General Education Requirements

In addition to the Kernel Program in Physics, courses to satisfy the General Education requirement and the physics elective requirement must be chosen from among all of the course offerings of the University subject to the following conditions:

1. All elective courses must be approved by the student's faculty advisor.
2. General Education requirement
 - a. college writing: two courses, six credit hours
 - b. literature: one course, three credit hours
 - c. historical studies: one course, three credit hours
 - d. aesthetics: one course, three credit hours
 - e. social and behavior studies: two courses, six credit hours
 - f. values, concepts, and choice: one course, three credit hours
 - g. mathematics: one course, three credit hours (met by the required mathematics courses)
 - h. sciences: three courses, nine credit hours minimum at least two courses that include experiential learning (met by the required science courses)
3. Technical electives required by the major

At least 13 credits (of which six must be from the Physics Electives list) in technical elective courses must be taken in a specialty field. These electives may

include courses outside the department. Elect - Magn II (3) [95.354] is strongly recommended for students intending to pursue a graduate degree in physics, as well as Introductory Quantum Mechanics I and II (3,3) [95.435/436]. Experimental Analysis for Physicists (1) [95.191] is required for students who have not taken 96.161 and 96.164 and have an insufficient background in experimental error analysis.

If the Optics Option is chosen, then included in the Physics Electives the student must take the courses listed below.

95.337	Geometrical Optics	3 cr
96.337	Geometrical Optics Lab	2 cr
96.338	Physical Optics Lab	2 cr
95.439	Electro-Optics w Lab	4 cr
95.440	Image Processing	4 cr

Successful completion of the Optics option will be certified by the Department on the student's transcript provided an official declaration form is filed at the end of the lower division program. See Physics Electives list for additional courses in optics.

Physics Electives

1. General Physics -

Upper Division (all but 95.191)

95.191	Exper Analysis for Physics Majors**	1 cr
95.212	Sophomore Physics Seminar	1 cr
95.312	Junior Physics Seminar	1 cr
95.354	Elect - Magn II*	3 cr
95.383	Astronomy & Astrophysics I3	3 cr
95.384	Astronomy & Astrophysics II3	3 cr
95.435	Intro Quantum Mechanics I*	3 cr
95.436	Intro Quantum Mechanics II*	3 cr
95.461	Nuclear Physics I	3 cr
95.472	Solid State Physics	3 cr
95.483	Relativity and Cosmology	3 cr
95.484	Relativity and Cosmology	3 cr
95.494	Elementary Particle Theory	3 cr
96.497	Senior Thesis	3 cr
96.498	Senior Thesis	3 cr
95.605	Mathematical Physics I	3 cr

95.606	Mathematical Physics II	3 cr
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Note: *Courses that are strongly recommended for students intending to pursue a graduate degree in physics.

**Experimental Analysis for Physics Majors (1) [95.191] is required for students who have not taken 96.161 and do not have a background in experimental error analysis and technical report writing

2. Optics - Upper Division

95.337	Geometrical Optics	3 cr
96.337	Geometrical Optics Lab	2 cr
96.338	Physical Optics Lab	2 cr
95.439	Electro-Optics w Lab	4 cr
95.440	Image Processing	4 cr
95.447	Laser Physics & Applic	3 cr
96.447	Experimental Laser Optics	2 cr
95.451	Fiber Optics	4 cr
96.453	Optics Project***	3 cr
96.454	Optics Project***	3 cr

***supervisor needed before registering

3. Radiological Health Physics Upper Division

95.355	Phys of Rad & Nucl	4 cr
95.401	Rad Safety & Control I	4 cr
95.402	Rad Safety & Control II	4 cr
95.411	Radiochemistry	3 cr
95.422	Env Rad & Nucl Site Cri	3 cr
95.462	Radiation Biology	3 cr
95.481	Math Methods of Rad Sci	3 cr
95.482	Numerical Methods in RS	3 cr
96.306	Nuclear Instrumentation	4 cr

Electives (definitions)

Gen Ed Elect - general education elective
Physics Elect - physics elective - upper division

Special Elect - specialty elective (specialization)

Elective - free elective

The Physics Minor

A student who has a basic background in physics and mathematics may be able to take more advanced physics courses. The goal of the physics minor program is to provide recognition for students in other majors who wish to enhance their understanding and mastery of a broader range of subjects than is provided in their major field alone.

The physics minor will establish the physics background needed to enter interdisciplinary fields such as Biophysics, Medical Physics or Material Science. In addition, a physics minor would be especially useful for students majoring in Biology, Chemistry, Mathematics, Earth Sciences, Engineering or Computer Science.

A minor in Physics consists of a minimum of 22 credits of physics courses.

All course prerequisites and corequisites must be satisfied. The requirements for the minor are:

Lower Division

A. Students must earn nine credits by completing either of the following physics sequences:

95.141	Physics I	3 cr
95.144	Physics II	3 cr
95.245	Phys. Prop. of Mat.	3 cr
	or	
95.161	Physics I (H)	4 cr
95.164	Physics II (H)	4 cr
95.269	Physics III (H)	4 cr

B.

96.141	Physics I Lab	1 cr
96.144	Physics II Lab	1 cr
	or	
96.161	Phys I Lab (H)	2 cr
96.164	Phys II Lab (H)	2 cr

C. one of the following:

96.260	Phys Instr	2 cr
96.295	Interm Exper Phys	2 cr

D.

95.210	Intro Modern Phys	3 cr
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Upper Division

E. Six cr. at or above 300 level 6 cr
Total Minimum 22 credits

Bachelor of Science Degree in Physics Standard Course of Study**Freshman Year****Fall Semester**

95.161*	Physics I (H)	4
96.161	Phys I Lab (H)	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3
		(6) 16

Spring Semester

95.112	Fresh Phys Sem	1
95.164*	Physics II (H)	4
96.164	Phys II Lab (H)	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3
		(7) 17

Sophomore Year**Fall Semester**

95.269*	Physics III (H)	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4
	Gen Ed Elect	3
		(6) 17

Spring Semester

95.210	Intro Modern Physics	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
	Elective	1
		(5) 13

Junior Year**Fall Semester**

95.353	Elect - Magn I	3
96.393	Adv Exper Phys I	2
92.301	Applied Math I	3
	Gen Ed Elect	3
	Gen Ed Elect	3
		(5) 14

Spring Semester

95.310	Quantum Physics	3
95.338	Optics and Waves	3
96.394	Adv Exper Physics II	2
92.302	Applied Math II	3
	Spec Elect	3
	Spec Elect	1
		(8) 15

Senior Year**Fall Semester**

95.411	Sen Phys Sem	1
95.413	Mechanics	3
95.421	Statistical Thermo	3
	Spec Elect (PH)	3
	Gen Ed Elect	3
		(7) 13

Spring Semester

95.452	Contemporary Physics	3
	Spec Elect (PH)	3
	Spec Elect	3
	Elective	3
	Elective	3
		(3) 15

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field requirement = 60 credits, SPECIALIZATION = 13 credits (6 must be in physics)

* alternative introductory calculus-based physics courses may be substituted with departmental approval

() number of specified physics credits.

Course of Study for Optics Option**Freshman Year****Fall Semester**

95.161*	Physics I (H)	4
96.161	Phys I Lab (H)	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3
		(6) 16

Spring Semester

95.112	Fresh Physics Sem	1
95.164*	Physics II (H)	4
96.164	Phys II Lab (H)	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3
		(7) 17

Sophomore Year**Fall Semester**

95.269*	Physics III (H)	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4
		(6) 14

Spring Semester

95.210	Intro Modern Physics	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
	Gen Ed Elect	3
		(5) 15

Junior Year**Fall Semester**

95.337	Geom Optics	3
95.353	Elect - Magn I	3
96.337	Geom Optics Lab	2
96.393	Adv Exper Phys I	2
92.301	Applied Math I	3

Gen Ed Elect 3
(10) 16

Spring Semester

95.310 Quantum Physics 3
95.338 Optics and Waves 3
96.338# Physical Optics Lab 2
92.302 Applied Math II 3
Gen Ed Elect 3
(8) 14

Senior Year**Fall Semester**

95.411 Sen Phys Sem 1
95.413 Mechanics 3
95.421 Statistical Thermo 3
95.439 Electro-Optics w Lab 4
Gen Ed Elect 3
(11) 14

Spring Semester

95.440 Image Proc w Lab 4
95.452 Contemporary Physics 3
Elective 3
Elective 3
Elective 1
(7) 14

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field requirement = 60 credits, SPECIALIZATION = 13 credits (6 must be in physics)

* alternative introductory calculus-based physics courses may be substituted with departmental approval

96.338 substitutes for 96.394 with respect to the Kernel

() number of specified physics credits

Course of Study for Radiological Health Physics Option**Freshman Year****Fall Semester**

95.161# Physics I (H) 4
96.161 Phys I Lab (H) 2
42.101 College Writing I 3
92.131 Calculus I 4

Gen Ed Elect 3
(6) 16

Spring Semester

95.112 Fresh Physics Sem 1
95.164# Physics II (H) 4
96.164 Phys II Lab (H) 2
42.102 College Writing II 3
92.132 Calculus II 4
Gen Ed Elect 3
(7) 17

Sophomore Year**Fall Semester**

95.269# Physics III (H) 4
96.295 Interm Exper Phys 2
84.121 Chemistry I 3
84.123 Chemistry I Lab 1
92.231 Calculus III 4
Gen Ed Elect 3
(6) 17

Spring Semester

95.204 Intro Rad Sciences 3
96.260 Phys Instr 2
84.122 Chemistry II 3
84.124 Chemistry II Lab 1
92.234 Differential Equations 3
92.263 Fortran Prog or
92.265 Pascal Prog 3
(5) 15

Junior Year**Fall Semester**

95.355 Phys Rad & Nucl 3
95.481 Math Meth RS 3
81.111 Princ Biology I* 3
92.386 Stat for Sci/Eng 3
Gen Ed Elect 3
(6) 15

Spring Semester

95.306 Nucl Instr 4
95.482 Num Meth RS 3
81.112 Princ Biology II** 3
81.252 Physiology*** 3

81.254 Physiology Lab*** 1
(7) 14

Senior Year**Fall Semester**

96.301 H P Intern I 3
95.401 Rad Saf & Contr I 4
Gen Ed Elect 3
Elective 3
(7) 13

Spring Semester

95.402 Rad Saf & Contr II 4
96.462 Radiation Biology 3
Gen Ed Elect 3
Elective 3
(7) 13

Total Program Requirement 120 credits

alternative introductory calculus-based physics courses may be substituted with departmental approval

* alternative 93.101/3 Life Science I & Lab (4 credits for 3)

** alternative 83.102/4 Life Science II & Lab (4 credits for 3)

***alternative 35.101/4 Anatomy & Physiology I/II (8 credits for 4)

() number of specified physics credits

Course of Study in Preparation for Graduate School in Physics**Freshman Year****Fall Semester**

95.161* Physics I (H) 4
96.161 Phys I Lab (H) 2
42.101 College Writing I 3
92.131 Calculus I 4
Gen Ed Elect 3
(6) 16

Spring Semester

95.112 Fresh Phys Sem 1
95.164* Honors Physics II 4
96.164 Honors Phys II Lab 2
42.102 College Writing II 3
92.132 Calculus II 4

Gen Ed Elect 3
(7) 17

Sophomore Year**Fall Semester**

95.269* Physics III (H) 4
96.295 Intern Exper Phys 2
84.121 Chemistry I 3
84.123 Chemistry I Lab 1
92.231 Calculus III 4
Gen Ed Elect 3
(6) 17

Spring Semester

95.210 Intro Modern Physics 3
96.260 Phys Instr 2
84.122 Chemistry II 3
84.124 Chemistry II Lab 1
92.234 Differential Equations 3
Gen Ed Elect 3
(5) 15

Junior Year**Fall Semester**

95.353 Elect - Magn I 3
96.393 Adv Exper Phys I 2
92.301 Applied Math I 3
Gen Ed Elect 3
Elective 3
(5) 14

Spring Semester

95.310 Quantum Physics 3
95.338 Optics and Waves 3
95.354 Elect - Magn II 3
96.394 Adv Exper Phys II 2
92.302 Applied Math II 3
Elective 1
(11) 15

Senior Year**Fall Semester**

95.411 Sen Phys Sem 1
95.413 Mechanics 3
95.421 Statistical Thermo 3
95.435 Quant Mech I 3

Gen Ed Elect 3
(10) 13

Spring Semester

95.436 Quant Mech II 3
95.452 Contemporary Physics 3
Spec Elect 3
Spec Elect 1
Elective 3
(6) 13

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field requirement = 60 credits, SPECIALIZATION = 13 credits (9 are specified)

* alternative introductory calculus-based physics courses may be substituted with departmental approval

() number of specified physics credits.

Course of Study in Preparation for M.Ed. Program**Freshman Year****Fall Semester**

95.161* Physics I (H) 4
96.161 Physics I Lab (H) 2
42.101 College Writing I 3
92.131 Calculus I 4
Gen Ed Elect 3
(6) 16

Spring Semester

95.112 Fresh Phys Sem 1
95.164* Physics II (H) 4
96.164 Physics II Lab (H) 2
42.102 College Writing II 3
Gen Ed Elect 3
(7) 17

Sophomore Year**Fall Semester**

95.269 Physics III (H) 4
96.295 Intern Exper Phys 2
84.121 Chemistry I 3
84.123 Chemistry I Lab 1
92.231 Calculus III 4

Gen Ed Elect 3
(6) 17

Spring Semester

95.210 Modern Physics 3
96.260 Phys Instr 2
84.122 Chemistry II 3
84.124 Chemistry II Lab 1
92.234 Differential Equations 3
Elective 3
(5) 15

Junior Year**Fall Semester**

95.353 Elect-Magn I 3
96.393 Adv Exper Phys I 2
45.334 Eng & Ethics 3
83.101 Life Science I 3
83.103 Life Science I Lab 1
92.301 Applied Math I 3
(5) 15

Spring Semester

95.310 Quantum Physics 3
95.338 Optics & Waves 3
96.394 Adv Exper Phys II 2
92.302 Applied Math II 3
Gen Ed Elect 3
(8) 14

Senior Year**Fall Semester**

95.411 Sen Phys Sem 1
95.413 Mechanics 3
95.421 Stat Therm 3
89.121 Phys Geology 3
89.123 Phys Geology Lab 1
Spec Elect (PH) 3
(7) 14

Spring Semester

95.452 Contemporary Physics 3
92.386 Statistics for Sci & Eng 3
Integrated Science Elect 3
Spec Elect (PH) 3
(3) 12

Total Program Requirement = 120 credits,
KERNEL = 47 physics

Credits, major field requirement = 60 credits,
SPECIALIZATION =

13 credits (6 must be in physics)

* alternative introductory calculus-based
physics courses may be substituted with
departmental approval

() number of specified physics credits

Physics - Primarily Lecture Courses (Prefix: 95)

95.101 Introductory Physics

A survey course for students majoring in
sound recording technology. Topics covered
include: one and two dimensional
motion, Newton's Laws of dynamics, statics,
circular motion, work and energy, linear
and angular momentum, electrostatics,
electric and potential fields, magnetic
fields, vibrations, waves, sound, Faraday's
Law and AC circuits. Corequisite: 96.101.
II(3,0)3

95.103 General Physics I

The first semester of a one-year course
which surveys the field of physics at a
non-calculus level. Topics include force
and motion, vectors, gravity, energy and
momentum, heat and thermodynamics,
and oscillations, waves, and sound.
Although the course emphasizes conceptual
understanding, a functional knowledge
of algebra and geometry is essential.
Corequisite: 96.103. I,II(3,0)3

95.104 General Physics II

A continuation of General Physics I.
Topics include electricity and magnetism,
geometrical and physical optics, modern
physics, atoms, and nuclei. Prerequisite:
95.103. Corequisite: 96.104. II(3,0)3

95.112 Freshman Physics Seminar

An introduction to the scientific methods
of physics and the exploration of research
opportunities for undergraduates. II(1,0)1

95.121 Exploring the Universe

Topics covered will include: Planet earth,
its structure, plate tectonics, greenhouse
effect, ozone layer, craters and dinosaurs;
out satellite - Moon; other planets; our star
- Sun and its energy source; other stars,
the HR diagram and stellar evolution,
white dwarfs, neutron stars, supernovae,
blackholes; our galaxy, the Milky Way, its

structure; other galaxies; the universe, its
structures and expansion; evolution of
galaxies, quasars, cosmology, the Big Bang
and unification of the forces of nature.
I,II(3,0)3

95.141 Physics I

First semester of a two-semester sequence
for science and engineering majors.
Mechanics including vectors, kinematics
in one and two dimensions, Newton's laws
of dynamics, work and energy, energy conservation,
linear momentum conservation,
rotational kinematics and dynamics,
Newton's Universal Law of Gravitation,
oscillatory motion and mechanical waves.
Corequisites: 92.131, 96.141. I,II(4,0)3

95.144 Physics II

Continuation of 95.141. Optics including
reflection, refraction, interference, and diffraction.
Electricity and magnetism
including Coulomb's Law, electric field,
Gauss' Law, electric potential, Ohm's Law,
DC circuits with resistors, magnetic field,
current loops, Ampere's Law, Faraday's
Law, inductance, Maxwell's equations, and
electromagnetic waves. Modern physics
including deBroglie waves, uncertainty
principle, photoelectric effect, hydrogen
atom and the stability of the Bohr orbits,
and atomic spectrum of hydrogen.
Prerequisite: 95.141. Corequisites: 92.132,
96.144. I,II(4,0)3

95.161 Honors Physics I

Introductory mechanics at a more challenging
level and the first semester of a
sequence for physics majors. Mechanics
of particles in one dimension, kinematics,
forces, dynamics; particles in two and
three dimensions, vectors, curvilinear and
oscillatory motion; conservation principles,
work, energy, linear momentum, collisions;
rotational mechanics, angular
momentum, torque and static equilibrium;
gravitation and planetary orbits; wave
motion, transverse and longitudinal, standing
waves. Corequisite: 92.131, 96.161.
I(4,0)4

95.164 Honors Physics II

Geometrical optics, reflection, refraction,
flat and curved mirrors, thin lenses; physical
optics, interference and diffraction;
electrostatics, charge, electric forces,
fields and flux, electric potential, capacitance
and field energy; electric charge in motion,
currents, DC and RC circuits;
magnetic fields, forces on moving charges,

magnetic field of an electric current, electromagnetic
induction, inductance, changing currents,
AC circuits; electromagnetic radiation; the
limits of classical electromagnetic theory.
Prerequisite: 95.161. Corequisites: 92.132,
96.164. II(4,0)4

95.191 Experimental Analysis for Physics Majors

A lecture series on measurement uncertainties
and error analysis. I(1,0)1

95.201 Principles of Physics I

The first semester of a calculus-based one-
year course for non-engineering majors
which surveys the field of physics. Topics
include motion, equilibrium, circular
motion, work, energy, momentum, elasticity,
vibrations, fluids and the laws of thermodynamics.
Prerequisite: 92.132. Corequisite: 96.103.
I(3,0)3

95.202 Principles of Physics II

A continuation of Principles of Physics I.
Topics include electric charge, fields, potential
and currents; magnetic fields, magnetic
induction, Maxwell's equations and electromagnetic
waves; wave optics, principles of quantum
mechanics and applications to atoms, matter,
and radiation. Prerequisite: 95.201. Corequisite:
96.104. II(3,0)3

95.204 Introduction to Radiation Sciences

This course is designed to introduce students
to the working practices encountered in health
physics. This is accomplished through field
trips to local facilities that use radioactive
materials, laboratory exercises, and class
discussions. This class exposes the student to
basic health physics procedures, vocabulary,
and equipment. II(3,0)3

95.210 Introductory Modern Physics

Special theory of relativity, experimental
basis of quantum theory, structure of the
atom, wave properties of matter, quantum
theory, hydrogen atom, atomic nucleus,
nuclear interactions and applications, and
semiconductors. Prerequisite: 95.144 or
95.164. II(3,0)3

95.212 Sophomore Physics Seminar

Discussions on current topics in physics.
II(1,0)1

95.245 Physical Properties of Matter

Fluid statics, dynamics of fluids, properties
of solids, advanced topics in waves and
vibrations, temperature and heat flow,

kinetic theory of gases, thermodynamics, and the limits of classical physics.

Prerequisites: 95.141 or 95.161,
Corequisites: 92.132, 96.245 II(4,0)3

95.269 Honors Physics III

Statics and dynamics of fluids, pressure, viscosity, Archimedes and Bernoulli principles, mechanical properties of solids, stress and strain, shear, electric and magnetic properties of materials, para- dia- and ferromagnetism, electro-mechanical and magneto-mechanical effects, hysteresis, advanced topics in waves and vibrations, damping, resonance in mechanical and AC oscillators, thermodynamics, Maxwell's velocity distribution, blackbody radiation, and the limits of classical physics, introduction to special relativity. Prerequisite: 95.144 or 95.164, Corequisites: 92.232, 96.295 or 96.245 I(4,0)4

95.310 Quantum Physics

Schroedinger's equation, one dimensional wells, simple harmonic oscillator, three-dimensional wells, hydrogen atom, electronic configuration, perturbation, helium atom, molecular structure and laser action. Prerequisite: 95.210. II(3,0)3

95.312 Junior Physics Seminar

Discussions on current topics in physics. II(1,0)1

95.337 Geometrical Optics

Properties of light, plane surfaces and prisms, thin and thick lenses, mirrors and stops, matrix methods applied to Gaussian (paraxial) optics, Lagrange-Helmholtz invariant, primary and chromatic aberrations, ray tracing and Abbe's sine condition, basic optical instruments including cameras, telescopes, and microscopes. Prerequisite: 95.245. I(3,0)3

95.338 Optics and Waves

Wave nature of light, mathematics of wave motion, electromagnetic theory of light propagation, reflection and refraction, Fresnel coefficients, polarization, interference, Young's experiment, fringe visibility and coherence, various interferometers, Newton's ring and applications, Fraunhofer diffraction by single and multiple apertures and diffraction gratings. Prerequisite: 95.245. II(3,0)3

95.353 Electromagnetism I

The theory of electromagnetic fields using vector analysis: electrostatic fields and potentials in vacuum, conductors, and

dielectric media, magnetic effects of steady currents in nonmagnetic media, magnetic induction and time varying currents and fields. (offered as 95.553 for graduate credit) Prerequisites: 92.234, 95.210. I(3,0)3

95.354 Electromagnetism II

Magnetic materials, electric multipoles, solutions to Laplace's equation, boundary conditions, image charge problems, Maxwell's equations; propagation of electromagnetic waves in vacuum, conductors and dielectrics; reflection and refraction of electromagnetic waves; radiation from dipoles and antennas. (offered as 95.554 for graduate credit). Prerequisite: 95.353. II(3,0)3

95.355 Physics of Radiation and Nuclei

A survey of atomic and nuclear physics directed to an understanding of the basic modern physics used in radiological science and nuclear engineering. Material covered includes but is not necessarily limited to the following topics: classical and relativistic relationships for momentum and energy, mass energy relationships, motion of charged particles in electric and magnetic fields, mass and charge of the electron, atomic mass and isotopes, the photon, the photoelectric effect, the Compton effect, wave particle dualism and probability, absorption of photons, scattering and scattering cross sections, Rutherford's nuclear atom, atomic spectra and Bohr's theory of the hydrogen atom, emission and absorption spectra and the selection rules, DeBroglie hypothesis, neutron diffraction, the Schroedinger wave equation, the uncertainty principle, systematics and structure of the nucleus, nuclear forces and nuclear models. (offered as 98.555 for graduate credit) Prerequisite: 95.144. II(3,0)3

95.383 Astronomy and Astrophysics I

This course is designed for an interdisciplinary general undergraduate (upper-classmen) audience. Fundamentals of astronomy and astromechanics, introductory survey of astrophysics and the solar system (i.e. planetary astronomy). I(3,0)3

95.384 Astronomy and Astrophysics II

Continuation of 95.383. Sun as a star, stellar and galactic astronomy, and cosmology. II(3,0)3

95.401 Radiation Safety and Control I

Introduction to radiation protection, including radiation sources, radiation dose and dose measurement, radiation exposure, radiation protection techniques, monitoring methods and instruments, contamination control and waste storage, facility design, hazards analysis, and applied health physics techniques for the safe handling and control of radioactive material including laboratory. (offered as 98.501 for graduate credit) Prerequisite: 95.355. I(3,3)4

95.402 Radiation Safety and Control II

A laboratory course giving students experience with equipment and practices of current use in the radiation protection field, and extension of 98.401 giving some of the practical aspects of radiation safety and control. (offered as 98.502 for graduate credit) Prerequisite: 95.401. II(3,3)4

95.411 Senior Physics Seminar

Discussions on the role of the professional physicist in society. I(1,0)1

95.413 Mechanics

Coordinate transformations and vectors; motion in one and three dimensions; oscillators: linear and non-linear and driven; non-inertial frames, central forces, collisions, planar motion of rigid bodies in two and three dimensions. Center of mass and moment of inertia, Lagrangians. (offered as 95.513 for graduate credit) Prerequisites: 92.301 and 95.144 or 95.164. I(3,0)3

95.421 Statistical Thermodynamics

An integrated study of the thermodynamics and statistical mechanics, review of the experimental foundations and historical development of classical thermodynamics; probability and statistical methods of studying macroscopic systems; atomic basis of the laws of thermodynamics and microscopic definitions of thermodynamics quantities using the method of ensembles; entropy and related quantities; TdS equations, Maxwell relations, equation of state, and applications: canonical and grand canonical ensembles; phase transitions; quantum statistics; application to radiation, magnetism, specific heats. (offered as 95.521 for graduate credit) Prerequisites: 92.301 and 95.310. I(3,0)3

95.422 Environmental Radiation and Nuclear Site Criteria

Study of sources, distribution, environmental transport and dose projections of environmental impact of nuclear fuel cycle. Offered as 98.522 for graduate credit. Prerequisite: introductory course covering basic nuclear concepts. II(3,0)3

95.435 Introductory Quantum Mechanics I

De Broglie waves, the Schroedinger equation, wave functions, wave packets, Heisenberg uncertainty principle, expectation values, particle in a box, the simple harmonic oscillator, free particles, step barrier, barrier penetration, square well potential, time independent perturbation theory. (offered as 95.535 for graduate credit) Prerequisite: 92.234 and 95.210. I(3,0)3

95.436 Introductory Quantum Mechanics II

The three dimensional Schroedinger equation, the deuteron nucleus, angular momentum, spin, the hydrogen atom, spin-orbit interaction, Zeeman effect, Pauli exclusion principle, atomic structure, multi-electron atoms, the Fermi gas, X-rays. (offered as 95.536 for graduate credit) Prerequisite: 95.435. II(3,0)3

95.439 Electro-Optics with Lab

Optical properties of materials, including dispersion, absorption, reflection and refraction at the boundary of two media. Crystal optics and induced birefringence and optical activity. Polarization states and Jones matrices. Applications to electro-optic devices. Experiments and projects involving the study of optical sources and detectors, spectroscopy, polarization, birefringence, pockels' effect, optical fibers, and optical communication. (offered as 95.539 for graduate credit) Prerequisites: 92.234, 95.338, 96.338. I(3,2)4

95.440 Image Processing

Basic physics of television and other imaging systems: representation and manipulation of images in digital form; Fourier analysis and filtering of images: detection of image features such as edges and regions; pattern recognition; three-dimensional visual perception in man and machine; examples of image processing tasks from such areas as medicine, industrial inspection and robotics; laboratory exercises with an image processing sys-

tem utilizing and Octec 2000 image analyzer and a Data General Nova 4/C Computer. Ability to program a computer is required. (offered as 95.540 for graduate credit) Prerequisites: 92.234, 95.338. II(2,3)4

95.441 Radiochemistry

This course stresses analytical techniques applicable to identification and quantification of radionuclides in various sample types. Considerable time will be spent on review of general chemistry and inorganic analytical chemistry. The theories and applications of various separation techniques including precipitation, solvent extraction, ion exchange chromatography, and electrodeposition will be discussed with emphasis on separation of radioactive species. Additional material to be covered includes instrumental techniques for analysis of radioactive species, radiotracer and isotope dilution techniques, neutron activation analysis, and sample preparation. (3,0)3

95.447 Laser Physics and Applications

Spontaneous and stimulated emission line broadening processing, rate equations, laser oscillation condition, spectral output of lasers. Gaussian beam propagation and resonator design parameters. Key features of ultraviolet through far infrared laser systems. Application to spectroscopy, radar, welding. (offered as 95.547 for graduate credit) Prerequisite: 95.335. II(3,0)3

95.450 Optics Project

A project to be completed by either an individual or two students working as a team to design and test an optical system which will involve a synthesis of a substantial number of optics principals and technique. II(3,0)3

95.451 Fiber Optics

Introduction to optical communications; basic theory of light guiding; propagation characteristics and focusing effect of an optical waveguide; optical sources and detectors for fiber communications; fundamental parameters of optical fibers, fabrication and testing methods for optical fibers. Laboratory experiments will include optical fiber parameter measurements, sensors, connectors, sources and detectors. (offered as 95.551 for graduate credit) I(2,3)4

95.452 Contemporary Physics

Capstone course for physics majors which uses symmetry principles and conserva-

tion laws to unify the physics of atoms, molecules, and solids: nuclei and elementary particles; and relativity and astrophysics. Atoms: review of the hydrogen atom using Schroedinger theory, many electron atoms including electronic states, addition of angular momenta and spectra; Molecules: the hydrogen molecule ion, H₂ molecule and the covalent bond, the ionic bond, molecular vibrations and rotations and molecular spectra; Solids: review of statistical physics both classical and quantum, cohesive energy of both ionic and covalent solids, band theory of solids for metals and semiconductors, application to quantum well devices. Nuclear sizes, shapes, masses and binding energies; nuclear force and models; radioactive decay and conservation laws; nuclear reaction cross sections, reaction kinematics, mechanisms, fission, fusion, particles and fields, conservation laws, families, interactions and decays, quark model and recent developments. Review of special relativity, general relativity, experimental tests of Einstein's theory, stellar evolution, nucleosynthesis; white dwarfs, neutron stars, black holes; structure and distribution of galaxies; cosmological red shift, cosmic microwave background, dark matter, relativistic cosmology, big bang model; formation of nuclei and atoms; Friedmann universes, Einstein-deSitter model, inflationary scenarios, open problems in cosmology. II(3,0)3

95.461 Nuclear Physics I

Nuclear properties including size, mass, binding energy, electromagnetic moments, parity and statistics; nuclear shell model, collective structure, deformed shell model, radioactive decay law and the Bateman equations, radioactive dating, counting statistics, energy resolution, coincidence measurements and time resolution, lifetime measurements; nuclear barrier penetration; angular momentum, Coulomb barrier, alpha decay and systematics, fission. (offered as 95.561 for graduate credit). Prerequisite: 95.336. I(3,0)3

95.462 Radiation Biology

Study of biological effects and mechanisms of action of ionizing radiations from subcellular through whole organism and ecological levels. (offered as 98.562 for graduate credit) Prerequisite: introductory nuclear course and course in human physiology. II(3,0)3

95.472 Solid State Physics

Crystal structures, x-ray diffraction, crystal binding, lattice vibrations, free electron and band models of metals. (offered as 95.572 for graduate credit). Prerequisites: 95.336 and 95.421. II(3,0)3

95.477 Solid State Electronic and Optoelectronic Devices

This course is an introduction to solid state electronic and optoelectronic devices for undergraduate science students (i.e. biology, chemistry, mechanical engineering, electrical engineering, physics, etc.) graduate students just entering a scientific endeavor which utilizes solid state devices, and practical engineers and scientists whose understanding of modern electronics and optoelectronics needs updating. The course is organized to bring students with a background in sophomore physics to a level of understanding which will allow them to read much of the current literature on new devices and applications. The course will cover fundamental crystal properties, atoms and electrons, energy bands and charge carriers, excess carriers, junctions and p-n junction diodes (includes photodiodes and light-emitting diodes). Three or four practical demonstrations will also be performed with the analysis of the generated data assigned as homework. (offered as 95.577 for graduate credit) I(3,0)3

95.478 Wave Guides and Diode Lasers

This course is a continuation of 95.477 and serves as an introduction to solid state electronic and optoelectronic devices. The course will cover bipolar junction transistors, field effect transistors, integrated circuits, lasers, switching devices, and negative conductance microwave devices. Three or four practical demonstrations will also be performed with the analysis of the generated data assigned as homework. (offered as 95.548 for graduate credit) II(3,0)3

95.481 Mathematical Methods of Radiological Sciences

An applied course emphasizing the mathematical skills used in radiological sciences/health physics fields, including special techniques used in radiation physics, radiation dosimetry, and radiation shielding. Computer applications will be emphasized. (offered as 98.581 for graduate credit) I(3,0)3

95.482 Numerical Methods of Radiological Sciences

Advanced mathematical treatment of topics covered in 98.481 with extensive application of computer techniques to problem solutions applicable to Radiological Sciences and Protection. (offered as 98.582 for graduate credit) Prerequisite: 95.481. II(1,6)3

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

95.605, 606 Mathematical Methods of Physics I-II

Vector and Cartesian tensor analysis; matrices and determinants; partial differential equations, boundary value problems, and special functions. Numerical analysis and applications; theory of analytical functions; Green's functions. I(4,0)4; II(4,0)4

95.607 Lie Algebras in Particle Physics

Introduction to group theory and its application to high energy physics; definition of a group and its representations; Lie groups and Lie algebras; study of SU (2) Lie algebra, its representations and the Wigner-Eckart theorem; isospin group; roots, weights and simple roots of simple Lie algebras and applications to the SU (3) group; tensor methods for lie algebras; SU (3) flavor symmetry; Young Tableaux for decomposing products of representations; SU (N) group; SU (6) and the Quark Model; the color SU (3) group and the theory of strong interaction of quarks; hadron mass; splittings using group theory; grand unification and the SU (5) group. Prerequisite: 95.616. (3,0)3

95.608 Introduction to Particle Physics

Introduction to quark models; unified gauge theory of weak and e.m. interactions; weak decays of leptons and hadrons; quantum chromodynamics and strong interactions of quarks and gluons; asymptotic freedom; the bound states of quarkonia; the E1 and M1 transitions in quarkonia. Prerequisites: 95.607 and 95.617. (3,0)3

95.611 Classical Mechanics

Review of fundamental principles of mechanics. Central force motion and sta-

bility problems. Lagrangian formulation, including Hamilton's principle; Lagrange multipliers. Coupled harmonic oscillators, normal modes. Hamiltonian formulation: Hamilton's equations, finite and infinitesimal canonical transformations, Hamilton - Jacobi method, and canonical invariants. Prerequisite: 95.513. I(3,0)3

95.612 Mechanics of Continuous Media

Continuum mechanics: vibrations of strings; introduction to Lagrangians of continuous systems; introduction to fluid mechanics; sound waves; viscous fluids; surface waves on fluids; introduction to tensor analysis, elastic continua. Prerequisite: 95.513 or 95.611 or equivalent. II(3,0)3

95.615 Quantum Mechanics I

The representation of quantum states as abstract vectors. Superposition of states. Quantum operators and their matrix representations. Angular momentum operator as the generator of rotations. Eigenvalues and eigenstates of angular momentum. The uncertainty principle. Spin one-half and spin one as examples. Addition of angular momentum. The Hamiltonian operator and the Schrodinger equation. One dimensional examples. The momentum operator, eigenstates of position. Operator solution of the harmonic oscillator. I(3,0)3

95.616 Quantum Mechanics II

Quantum mechanics in three dimensions. translational and rotational invariance and conservation of linear and angular momentum, center-of-mass coordinates. Position-space representation of the angular momentum operator, orbital angular momentum eigenfunctions. Bound states of central potentials, including the Coulomb potential and the hydrogen atom. Approximation methods: time-independent perturbations, applications to the Stark effect, the Zeeman effect, spin-orbit coupling in hydrogen. The variational method. Time dependent perturbations. Indistinguishable particles: multielectron atoms, covalent bonding. Scattering. Electromagnetic interactions: emission and absorption of radiation. Prerequisite: 95.615 or permission of instructor. II(3,0)3

95.617 Advanced Quantum Mechanics I

Dirac equation as a single particle wave equation, free particle spinors and plane waves, matrices and relativistic covari-

ance, nonrelativistic approximation and the fine-structure of the H atom. Quantization of the e.m. field in the coulomb gauge; interaction of an atom with the quantized radiation field; radiative transitions in atoms; Thomson scattering; classical and quantized Lagrangian field theory; symmetries and conservation laws: quantization of the real and complex Klein-Gordon field; Dirac Field and the covariant quantization of the e.m. field; Feynman propagators; the interaction picture and the S-matrix expansion in perturbation theory and the Wick's Rule. Feynman diagrams and rules for calculating S-matrix elements in QED; formulas for cross-section and spin and photon polarization sums; calculation of cross-sections for (1) $e^+e^- \rightarrow l^+l^-$ (2) $e^+e^- \rightarrow e^+e^-$ (3) Compton scattering and (4) scattering of electrons by an external e.m. field. Prerequisite: 95.616. I(3,0)3

95.618 Advanced Quantum Mechanics II

Radiative corrections to processes in quantum electrodynamics; mass and charge renormalization; dimensional regularization; vacuum polarization; anomalous magnetic moment of the electron and the Lamb-shift; unified gauge theory of electro-weak interactions; W and Z bosons and their properties; introduction to quantum chromodynamics. Prerequisite: 95.617. (3,0)3

95.631 Nonlinear Optics

Brief review of linear optics and optical waves in anisotropic linear media. Wave propagation in nonlinear media. Acousto-optics. Second order nonlinear optical phenomena: sum and difference frequency generation; parametric amplification, Pockels effect and electro-optic modulators based on them. Third order nonlinear optical phenomena: third harmonic generation, simulated Raman scattering stimulated Brillouin scattering, intensity dependent refractive index and Kerr effect. Magneto-optical phenomena and the physics of photo-refractive materials. I(3,0)3

95.632 Integrated Optics

Planar optical waveguide modes. Waveguide fabrication methods. Losses in optical wave guides. Input and output couplers. Coupling between wave guides. Electro-optics and acousto-optic modulators. Semiconductor lasers and detectors. (3,0)3

95.657 Electromagnetic Theory I

95.658 Electromagnetic Theory II

Electrostatics and magnetostatics with special attention to boundary value problems. Quasistatic fields and displacement currents. Maxwell's equations, special relativity, waveguides, scattering, radiation from accelerated charges; propagation in material media and plasmas, Kramers-Kronig relations. Prerequisite: 95.606. I(4,0)4; II(4,0)4

95.660 Quantum Mechanics of Many Particle Systems

Non-relativistic quantum mechanics of many-particle systems, having application to many-electron atoms, molecules, condensed matter and nuclei. Selection of topics varies and may include Hartree-Fock and Fermi-Thomas and their modern descendants: X-alpha, Green's Functions, Feynman graphs, density functionals; applications of group theory to symmetric clusters of atoms. Prerequisite: 95.616. (3,0)3

95.662 Nuclear Physics II

The nucleon-nucleon force; nuclear models; nuclear reaction theory and partial wave analysis of scattering; fast neutron physics. Prerequisite: 95.561. II(3,0)3

95.673 Advanced Theory of Solids I

95.674 Advanced Theory of Solids II

Lattice vibrations and their interactions with X-rays, neutrons and light. The band model of solids and energy band calculations; the Fermi surface. Transport and optical properties in metals and semiconductors. Magnetism and magnetic resonance; superconductivity. Many-body theory and applications; collective excitations; Green's function techniques in solid state physics. Prerequisite: 95.616. I(3,0)3; II(3,0)3

95.675 Neutral Particle Transport I

95.676 Neutral Particle Transport II

Boltzmann and integral transport equations. Spherical harmonic and variational methods. Corrections to diffusion theory. Special methods of solving transport equations. Adjoint functions. Applications. I(3,0)3; II(3,0)3

95.683 General Theory of Relativity I

95.684 General Theory of Relativity II

Review of Newtonian gravitational theory and special relativity. Principles of equivalence. Tensor analysis in Riemann spaces.

Einstein's field equations; tests of Einstein's theory. Spherically symmetric solutions. Applications in astrophysics and cosmology. I(3,0)3; II(3,0)3

95.686 Semiconductor Physics

Transport and optical properties of semiconductors. Statistics, collision mechanisms, effective mass theory, donors and acceptors. Hot electrons. High magnetic field phenomena. Devices: junctions and transistors. Gunn oscillators; semiconductor lasers. Prerequisite: 95.472. (3,0)3

Physics - Primarily Laboratory Courses (Prefix: 96)

96.101 Introductory Experimental Physics

Experimental physics with topics correlated with the corequisite lecture course. Corequisite: 95.101 II(0,2)1

96.103 Experimental General Physics I

The first semester of a year course which surveys the field of experimental physics with topics correlated with the corequisite lecture courses. Corequisite: 95.103 or 95.201. I,II(0,2)1

96.104 Experimental General Physics II

A continuation of 96.103 with topics correlated with the corequisite lecture courses. Prerequisite: 96.103. Corequisite: 95.104 or 95.202. II(0,2)1

96.121 Exploring the Universe Laboratory

Laboratory exercises to illustrate the basic principles and measurement techniques of astronomy. Quantitative techniques, properties of angles, modeling the earth-sun system, comparative planetology, the constellations, the inverse square law, black-body radiation and spectra, the Hertzsprung-Russell diagram, distances to the stars, the Andromeda galaxy, cosmology. Corequisite: 95.121. I,II(0,2)1

96.141 Experimental Physics I

An introductory course on methods and techniques of experimentation in physics with experiments in mechanics selected to support the concepts of the corequisite lecture course. Corequisite: 95.141. I,II(0,2)1

96.144 Experimental Physics II

A continuation of 96.141 with experiments in optics, electricity and magnetism, and

modern physics to support the concepts of the corequisite lecture course.

Prerequisite: 96.141. Corequisite: 95.144.

I,II(0,2)1

96.161 Honors Physics I Laboratory

An introductory laboratory course at the honors level on the methods and techniques of experimental physics. Lectures on measurement uncertainties and error analysis are included and experiments are selected principally in mechanics.

Corequisite: 95.161. I(1,3)2

96.164 Honors Physics II Laboratory

A continuation of 96.161 with experiments selected principally in optics, electricity and magnetism. Prerequisite: 96.161.

Corequisite: 95.164. II(0,4)2

96.201/96.301 Health Physics Internship I

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisites: radiological health physics major, 95.204, and approval of program coordinator. I(0,9)3

96.202/96.302 Health Physics Internship II

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisite: radiological health physics major, 95.204, and approval of program coordinator. II(0,9)3

96.245 Physical Properties of Matter Laboratory

Experiments are selected principally in properties of solids, vibrations, waves, heat, and thermodynamics. Prerequisite: 96.141, Corequisite: 95.245 II(0,2)1

96.260 Physical Instrumentation

Introduction to measuring devices emphasizing practical physical applications. Topics covered will include both analog and digital techniques, fundamentals of transistors, diodes, integrated circuits, operational amplifiers, filters, digital circuits, and logic elements. II(1,3)2

96.295 Intermediate Physics Laboratory

A course in experimental physics, with related theoretical material. Experiments are principally in the area of electrical measurements. Lectures are given on labo-

ratory techniques and practices.

Prerequisite: 95.144 or 95.164. I(1,3)2

96.306 Nuclear Instrumentation

Operating principles and applications of nuclear radiation detectors, associated electronic signal processing equipment, data analysis techniques. Topics covered include charged-particle, photon, and neutron detection, plus charged-particle and gamma-ray spectroscopy. Use of scintillators, photomultiplier tubes, solid state detectors, gas-filled counters, oscilloscopes, etc. (offered as 98.506 for graduate credit) Prerequisites: 95.355, 96.260. II(2,4)4

96.337 Geometrical Optics Laboratory

Experiments in geometrical optics covering the following topics; alignment techniques, reflection, thin and thick lenses, telescope, microscope, spherical mirrors, lens aberrations, radiometry and photometry. Prerequisites: 95.144 and 96.144 or 96.148. I(0,6)2

96.338 Physical Optics Laboratory

Experiments in physical optics covering the following topics; Michelson and Twyman-Green interferometers, Newton's rings, optical testing, multiple beam interference, diffraction grating, spectroscopy, Fresnel and Fraunhofer diffraction, reflection of light from a dielectric surface, polarization, holography. Prerequisite: 96.337. Corequisite: 95.338 or permission of the instructor. II(0,6)2

96.393 Advanced Experimental Physics I

Experiments in various branches of physics including optics and atomic physics. Prerequisite: 96.260. I(0,6)2

96.394 Advanced Experimental Physics II

A continuation of 96.393 with experiments selected mainly from condensed matter and nuclear physics. Opportunities for independent work by permission of the instructor. II(0,6)2

96.411/412 Senior Research in Radiological Sciences I/II

A research problem related to the field of radiation protection is investigated by the student under the direction of faculty and staff of the Nuclear Center. The student will present a seminar on this research project. Areas of research may include

radiation shielding, radiation detection and measurement, radiation survey and monitoring, radiation biology, radiation chemistry, radiobiology, radiochemistry, radioecology, natural radioactivity, fallout, analyses and measurement of radioactivity and radiation levels associated with the operation of reactors and accelerators, and radioactive aerosols. Prerequisites: senior status as a major in the radiological health physics option and approved proposal. I,II(0,9)3

96.443 Radiochemistry Laboratory

This laboratory course will require the completion of between four and six separate laboratory procedures and participation in two to four demonstration sessions. Laboratories will stress various analytical techniques for determination of specific radionuclides. At least two laboratory sessions, which may extend more than one period, will deal with analysis of environmental samples of specific radionuclides. A variety of separation procedures including precipitation, solvent extraction, ion exchange chromatography, gas deemanation, and electro-deposition will be employed. (0,3)1

96.447 Experimental Laser Optics

Experiments investigate the characteristics of laser beams (mode structure, linewidth, coherence properties, beam divergence, etc.). A variety of CW and pulsed lasers in the UV, visible and the near IR will be used. Demonstration experiments include Q-switching, harmonic generation and stimulated Raman frequency shifting of lasers. Additional instrumentation such as a box-car averager and lockin amplifier will also be used for some measurements. (offered as 96.547 for graduate credit). Prerequisite: permission of instructor. II(0,6)2

96.451 Special Topics in Radiological Sciences I

This course is used to provide students with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. (offered as 98.551 for graduate credit) Prerequisite: senior status as a major in the radiological health physics option. I(3,0)3

96.452 Special Topics in Radiological Sciences II

This course is used to provide students

with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. (offered as 98.552 for graduate credit) Prerequisite: senior status as a major in the radiological health physics option. II(3,0)3

96.495 Special Research Problems I
Special problems in physics assigned to the individual student with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of department chairperson and instructor. I(0,9)3

96.496 Special Research Problems II
A continuation of 96.495 for a second semester. Prerequisite: permission of department chairperson and instructor. II(0,9)3

96.497 Undergraduate Thesis I
Research in experimental and/or theoretical physics. Progress report required. Prerequisite: permission of department chairperson and thesis supervisor. I(0,9)3

96.498 Undergraduate Thesis II
A continuation of 96.497. A written thesis and seminar are required. Prerequisite: permission of department chairperson and thesis supervisor. II(0,9)3

Courses for Non-Majors (Prefix: 99)

99.101 Radiation and Life
This course will provide students with an understanding of the nature, sources, uses, and biological effects of natural and man-made radiations. Radiations discussed include non-ionizing radiations such as ultra violet and microwave as well as the ionizing radiations produced by radon in homes and radionuclides released from nuclear power plants. Students will have a better understanding of the risks and benefits of radiation in the modern world. I,II(3,0)3

99.102 Radiation and Life Laboratory
This laboratory course which is suitable for non-science majors will provide the student with an opportunity for some hands-on experience with modern equipment used to identify and quantify levels of radioactivity in the environment. Students will measure radiation from a variety of sources and will determine con-

centrations of radionuclides in several environmental samples including making measurements of the radon levels in the air of their own homes. Students will also study the effects of ionizing radiation on the germination and growth rate of exposed seeds. Corequisite: 99.101. I,II(0,3)1

Radiological Sciences - Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

98.611 Preparation for Health Physics Certification

Students have intensive review of problems from historical certification examinations and review of current federal

regulations related to applied health physics. Prerequisite: 98.501. (3,0)3

98.514 External Radiation Dosimetry
Radiation quantities and units; beta, gamma and neutron dosimetry; principles of charge measurement and energy transfer; use and calibration of instruments; calibration sources; accident dosimetry; standards and regulations. Prerequisite: 95.401/402. (3,3)4

98.516 Internal Radiation Dosimetry
Physiological models for reference man; metabolic models and kinetics; ICRP publications; bioassay models; accident internal radiation dosimetry; standards and regulatory requirements. (3,0)3

98.646 Accelerator Health Physics
Health physics problems common to particle accelerator facilities are presented with discussions of current approaches to their solutions. Estimation of the levels of induced radioactivity expected and calculations of shielding and ventilation requirements will be made for a variety of particle accelerators. Prerequisites: 95.401,402. (3,0)3

98.666 Reactor Health Physics
Health physics problems associated with nuclear reactor facilities with emphasis on commercial nuclear power including the radiation protection program elements needed for the control of external and internal radiation sources for the safe and efficient operations of these facilities. Prerequisites: 95.401,402.

98.596 Medical Physics
A discussion of the methods and proce-

dures involving the use of radiation and radioactive materials in medical diagnosis and therapy, including medical radiation dosimetry and computer applications. (3,0)3

Department of Political Science

William Lindeke, Chairperson

Professors: Frederick Lewis, William Lindeke, Hai Ba Pho

Associate Professors: Joyce Denning (Emerita), A. 'Nick' Minton

Assistant Professors: Susan Gallagher, Jeffrey Gerson

Affiliated Faculty: Dean Bergeron, John Wooding

Department Location: Coburn Hall, Room 114

Telephone: (978) 934-4123

The Political Science Department offers a major leading to the Bachelor of Arts degree and also a minor program of study.

Political Science Major

The Political Science Department's commitment to excellence in undergraduate teaching has yielded an enviable number of graduates successful in law, government, education, communications, and business. The major in Political Science is designed to provide a knowledge of the nature of politics and government on the local, state, national, and international levels and of the functions and theories of the state. The courses enable the student to develop an understanding of the political process and an ability to analyze political systems, relationships, and problems. The major affords excellent preparation for graduate education, law school, public administration, public service, social science teaching and, most importantly, intelligent citizenship.

The Department of Political Science provides a full complement of core courses, including introductions to research methods and to the discipline itself. The department offers practica, computer-modeling opportunities, and encourages participation in Model International Organization programs. It sponsors internships and individualized research opportunities for its students. Opportunities to spend a semester in Washington, D.C. under the auspices of the Washington Center Internship Program while earning 15 semester hours of academic credit are eas-

ily arranged. Also, arrangements may be made for credit through study-abroad programs.

The introductory courses for majors strengthen the freshmen experience and create common bonds among students. Core offerings on American Politics and Policy have been augmented by others on comparative politics of countries ranging from Eastern Europe to Russia and the former Soviet Union to Southeast Asia to Southern Africa.

The department also offers specialized courses related to gender and citizenship, political economy, race and ethnicity, and public policy of interest to students in a variety of majors across the university.

In addition to traditional courses in political thought, recent course offerings have included work in state theory, feminist political theory, current theoretical conflicts in constitutional interpretation, and the politics of arts and culture.

Overall credit hour requirement: A major in Political Science consists of 36 credits (i.e., a three-credit Practicum and 33 other credits) to a maximum of 45 credits. At least 15 credits must be taken at the 300 course level or above.

Specific course requirements:

1. 46.101 Intro to American Politics

Normally taken fall semester of the freshman year; a "majors only" section facilitates department cohesion for entering freshmen and helps them not to feel "lost";

2. 46.201 Intro to Political Analysis

Meets the human values requirement of the University core curriculum for political science majors. It is normally taken spring semester of the freshman year and may be waived for upper division transfer students. This course surveys the scope and methods of political science;

3. 46.301 Research and Writing in Political Science

Normally taken spring semester of the junior year as a prelude to writing a senior thesis which is done in 46.401;

4. 46.401 Research Seminar in Political Science

Requires writing a substantial thesis paper and is normally taken fall semester of the senior year, after completion of 46.301;

5. One three-credit practicum course which will be graded "satisfactory" or "unsatisfactory." Take either 44.496 Practicum experience or 44.497 Practicum in the Law, or another practicum, if offered. The practicum involves 70-100 hours of practical experience in politics, law, government etc. Students may not take more than one practicum as part of the minimum

120 credits required for graduation without prior Department approval.

Distribution requirement: the Department also requires at least one course in addition to any specifically required courses in four of the following five areas: 1) American Politics and Law, 2) Comparative Politics, 3) Political Thought and Theory, 4) International Relations and Organizations, and 5) Public Policy and Administration.

Focus requirement: In conjunction with a faculty advisor, political science majors are encouraged to formulate a program of study in the major that includes three to five courses that focus in a progressively more advanced manner upon one political science sub-area to assure a depth of knowledge. Sub-areas may be defined flexibly.

Waiver of any requirement may be granted only by the Department Chair in unusual circumstances and for very good reasons.

The Department recommends that Political Science majors select supporting coursework from history, sociology, and economics, and encourages students to develop minor areas of study or supporting majors in related social science disciplines.

Students transferring to the college and wishing to major in Political Science must make individual arrangements with their faculty advisor or the Department Chairperson regarding satisfaction of major course requirements.

Career Opportunities

Many Political Science majors pursue careers in public affairs on the staffs of elected officials, government agencies, public interest groups, or corporate public affairs departments. Journalism, broad-

casting, public relations and other communications-related professions have also been of interest to majors. The major also provides good training and skills for other business applications.

As part of the required Practicum, over the years, student majors have pursued internships involving all of these areas. The Department of Political Science currently helps administer a paid summer internship in a Congressional office and it receives and posts notices of many other significant internship opportunities in governmental and non-governmental settings.

Because many Political Science majors are interested in pursuing careers in the legal field, the Department offers several course opportunities in the legal-political area. In appropriate instances, this may include a practicum course that provides exposure to legal practice. Political Science majors may also elect the interdisciplinary legal studies minor; however, political science courses utilized for the minor may not also be credited to the major, and the number of political science courses taken for the major and minor together may not exceed 45 credits within the minimum 120 credits required for graduation.

Minor Requirements

Political Science

Political Science as a minor area of study consists of 18-24 credits of coursework. At least six credits must be taken in coursework at the 300 level or above.

Coursework is selected by the student in consultation with an advisor. Students who desire to make the most effective use of a minor in Political science in pursuing specific career objectives in occupational areas such as law, foreign service, business, management, higher education, and public service should consult with the political science faculty in choosing courses which are most appropriate as preparation for such career objectives.

General Requirements

For students entering the University in Fall 1993 and subsequently:

A major in political science consists of 36 credits (i.e. three credit Practicum and 33 other credits) to a maximum of 45 credits. At least 15 credits must be taken at the 300 level or above.

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics* (Gen Ed)	3
46.101	Intro to American Politics	3
	Beh & Soc St (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
46.201	Political Analysis**	3
	Beginning Language II	3
46.	Distribution Requirement***	3
		15

Sophomore Year

Fall Semester

46.	Distribution Requirement***	3
	Beh & Soc St (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language I	3
	Historical Studies (Gen Ed)	3
		15

Spring Semester

46.	Distribution Req.***	3
	Literature (Gen Ed)	3
46.	Focus Requirement****	3
	Intermediate Language II	3
	Free Elective	3
		15

Junior Year

Fall Semester

46.	Distribution Requirement***	3
46.	Focus Requirement****	3
	Aesthetics (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

46.	Distribution Req***	3
46.	Focus Requirement****	3
46.301	Res & Writing in Poli Sci	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

46.401	Research Seminar in Politics	3
46.	Distribution or Free Elective***3	
46.	Focus Requirement****	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

46.496	Practicum Experience or	
46.497	Practicum of the Law	3
	Focus or Free Elective****	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Consult the Academic Policy section of this catalogue regarding the General Education requirements for mathematics and sciences.

**The Values, Concepts and Choice requirement is met for majors by taking Political Analysis (46.201).

***Distribution Requirements: The department also requires at least one course in four of the following five sub-areas:

American Politics and Law
Comparative Politics
Political Thought & Theory
Public Policy & Administration
International Relations & Organizations

****Focus Requirements: In conjunction with a faculty advisor, political science majors are encouraged to formulate a program of study in the major that includes three to five courses that focus in a progressively more advanced manner upon one political science sub-area to assure a depth of knowledge.

Waivers of any requirement may be granted only by the department chair in unusual circumstances and for a very good reason.

The Department recommends that political science majors select supporting course work from economics, history, and sociology and encourages students to develop minor areas of study or supporting majors in related social science disciplines.

Political Science Courses(Prefix: 46)

46.101 Intro to American Politics

An introduction to the politics, structure, and behavior of the American National Political Community. 3 cr

46.110 Intro to Politics

An introductory exploration of basic political concepts, ideologies, and themes. Stresses the importance of understanding politics for everyday life. 3 cr

46.112 Intro to Comparative Political Systems

A cross-cultural analysis of various governmental systems; elements common to all forms of government are emphasized and variations among contemporary political systems are discussed. Balance between developed and Third World countries. 3 cr

46.121 Intro to International Relations

Introductory survey of recent methods and approaches used in the study of international politics; focus on current foreign policy problems of the major world powers. 3 cr

46.201 Intro to Political Analysis

Introduces the Political Science major to the scope of politics as a discipline. Highlights value questions through analysis of the political, socio-demographic and constitutional background of selected contemporary public issues and policies. 3 cr

46.205 Intro to Political Economy

The artificial boundaries between political and economic analysis are transcended as current problems in political economy are surveyed, examined and analyzed. 3 cr

46.215 Intro to Public Policy

The relationship between the political

process and contemporary public policy issues, particularly those involving scientific and technological concerns, is examined through selected case studies and other readings. 3cr

46.220 Intro to Gender and Politics

An exploration of the way ideas about gender have shaped politics and government. 3 cr

46.221 Writing about Politics

An introduction to political research and writing. Recommended for majors and other students interested in teaching, public relations, communications, and other writing-intensive fields. 3 cr

46.225 Gender, Work, and Politics

An examination of the role of gender in class relations, economic conditions, political development, and social change. 3cr

46.230 Intro to Law & the Legal System

An introduction to the nature of the legal process and the operation of the American legal system; consideration of its political and social functions. 3 cr

46.231 Intro to Political Thought

A critical survey of the history of Western political thought from Plato to the present. 3 cr

46.235 Intro to the Law & Politics of Constitutional Government

An introductory study of Constitutional Law and Politics; analysis of constitutional doctrine and the American constitutional system, with emphasis on contemporary controversies. 3 cr

46.237 Intro to the Law and Politics of Civil Liberties

An introductory study of Civil Liberties Law & Politics; analysis of constitutional doctrine and related materials with emphasis on contemporary controversies. 3 cr

46.265 Intro to American State and Local Government

Examination and study of politics and government at the state and local levels, with emphasis on Massachusetts and New England. Practitioners from state and local government will meet with the class. 3 cr

46.301 Research and Writing in Political Science

A review of academic research and writing

techniques. Designed to facilitate definition of senior theses and as preparation for other major writing projects. 3 cr

46.302 Qualitative Research Methods

A hands-on exploration of various qualitative methodologies, including oral history, participant observation, and focus groups. The course will also examine the theoretical underpinnings of qualitative methods and their ethics and legalities. Students will also learn how to use professional audio and video equipment. 3 cr

46.307 American Political Thought

A survey of the historical development of American political thought from the colonial era to the present. 3 cr

46.309 Political Socialization

An in-depth examination of the acquisition of political attitudes and values within the American political system. 3 cr

46.310 Contemporary Political Theory

An examination of major ideological currents in the contemporary world. Topics include fascism, anarchism, socialism, nationalism, liberalism and postmodernism. 3 cr

46.311 Political Obligation

Analysis of selected classical and modern theories of obligation including consensus, organic, prescriptive, and utilitarian models. Also examined are related problems and topics such as legitimacy, authority, justice, freedom, order, change, violence and civil disobedience. The similarities and differences among political, legal and moral obligations are considered. 3 cr

46.315 Politics of Arts and Culture

An analysis of political and theoretical perspectives in arts and culture. 3 cr

46.316 Politics and Film

An analysis of political ideas, movements and institutions through the use of American and International films. Examines film as art and commodity; as reflection or creator of political culture. 3 cr

46.317 Politics and Music

A study of politics through the analysis of several musical genres (pop, blues, country, folk, jazz, and rock n' roll). The course examines the relationship between music and political power, popular music as a form of mass culture, how music transforms and is reflected in American politics, the interplay between dominant

and oppositional ideologies, how musicians address the key issues of their times and the changing face of the commercial music business. Live musical performance and discussion by nationally and regionally recognized performers is featured. 3 cr

46.320 Feminist Political Theory

An analysis of the theoretical perspectives of contemporary feminism. 3 cr

46.321 Gender, Law, and Politics

An investigation of the legal aspects of the struggle for sexual equality in the United States. 3 cr

46.335 State, Bureaucracy and Policy

Analyzes theoretical perspectives on the State, bureaucracy and policy-making. Examines dominant theories of the State and applies them to practical policy questions. 3 cr

46.336 Public and Private in American Politics

An exploration of the shifting boundaries between the public and private spheres in American political life. 3 cr

46.338 Political Participation

Political movements; voting and elections, parties and interest groups; civil disobedience in American politics. Consideration of causes, fluctuations and trends. 3 cr

46.340 American Politics

American Politics in an Era of Transition. An advanced study of interpretations of conflicts, problems and challenges in the American Political Culture, Political Economy, and Society at a time of change. The resulting political cleavages and coalitions; political campaigns and elections; traditional and contemporary party systems. 3 cr

46.343 The Congress

Legislative Politics. An advanced study of representation, campaigns and elections, and the functioning of the American national congress within the American political system. 3 cr

46.344 The American Presidency

An examination of the nature of the American presidency and its functioning within the American political system. Specific attention is given to the problems and evolution of the presidency since World War I. 3 cr

46.345 Constitutional Law and Politics

An advanced study of American constitutional doctrine as it has developed historically through the process of constitutional adjudication. 3 cr

46.347 Civil Liberties

An advanced study of the meaning of liberty in America is pursued through an examination of the development of constitutional doctrine and the resulting nationalization of American concepts of civil liberty. 3 cr

46.349 Politics of Race and Ethnicity

A study of the politics of race and ethnicity, focusing primarily on American society, and the racial and ethnic groups of the region. 3 cr

46.350 Urban Politics and Policy

A study of political power in, and the political structures of urban areas and the major issues and conflicts currently confronting them. 3 cr

46.352 Science, Technology and Public Policy

An advanced examination of selected scientific and technological policy issues; consideration of the relationship between government policy and technological development. 3 cr

46.353 Public Administration and Public Policy

An examination of the little studied fourth branch of government. Bureaucratic power in the American political system is reconsidered. 3 cr

46.357 Environmental Policy

American environmental values and politics; attitudes and behavior towards the environment. Special attention to current issues. 3 cr

46.360 European Politics: Tradition and Modernity

An analytical examination of selected modern European political systems, emphasizing similarities and differences in political culture, behavior, institutions, and performance. 3 cr

46.361 Southeast Asian Politics

A study of Southeast Asian countries, their anti-colonial struggles and their patterns of political development. Attention is also given to the recent struggle among the former Indochinese states and the broader

international involvement in the region. 3 cr

46.363 Politics of China

A study of the recent development of governmental institutions, parties, and ideology in China. Emphasis is placed on the processes of nation-building in the post World War II period. 3 cr

46.366 Politics of Russia and the Former Soviet Union

Conflict and Change in the former Soviet Union. An examination of the relationship of politics to the functioning of post-Soviet societies. The influence of politics on economy, education, family life, religion, etc. 3 cr

46.367 Europe: The Tensions of Postmodern Politics

A comparative examination of the politics of several smaller European countries whose governments have attempted to incorporate significant social democratic aspects into their societies. Countries considered include: Sweden, Spain, Hungary, Czech Republic, and Italy. 3 cr

46.368 Middle Eastern Politics

An appreciation of Middle Eastern attitudes and values is utilized in developing insight into the tensions that exist within the Middle East and between the Middle East and the Western world. 3 cr

46.369 British Politics

An examination of the history and development of British politics. Focuses on the post-1945 era. 3 cr

46.371 Caribbean Politics

A comparative study of the political, social, cultural and economic forces that have led to the current situations in the countries of the Caribbean area (Mexico, Central America and the islands). 3 cr

46.373 Politics of Southern Africa

An examination of the changing politics of the twelve countries of Southern Africa. Topics include colonialism, revolution, democracy, apartheid, and development among the Southern African Development Community states. 3 cr

46.374 Democracy and Development

Explores the theories and experiences of countries newly converting to democracy in Asia, Africa, Latin America and the former Eastern Bloc. Also examines the strategies and prospects for development among the same countries. 3 cr

46.375 Politics of Japan and the Pacific Rim

An examination of the politics, policies and institutions of Japan, the "four tigers", and other countries of the Pacific rim area. 3 cr

46.377 Politics in the Global Economy

An examination of the political consequences of the rise of global capitalism. 3 cr

46.378 International Political Economy

An examination of the politics of global economic relations stressing the role of international institutions, multinational corporations and other international actors on the policies of the nation-state. 3 cr

46.380 American Foreign Policy

A study of the processes of American foreign policy in the contemporary world. 3 cr

46.382 The Vietnam War

A study of U.S. foreign policy in Indochina and the international developments resulting in U.S. involvement in Indochina after World War II. Emphasis placed on the U.S. role in the 2nd Indochina War and the intensive domestic and international repercussions. 3 cr

46.383 Southeast Asians in the USA

A study of US refugee policy and the experience of recent immigrants from Southeast Asia. 3 cr

46.385 Computer-Assisted Study on Diplomacy

An in-depth case study of international conference and treaties including current diplomatic negotiations of international conflicts. Computers and Internet teleconferencing are extensively used by students organized in country-teams to simulate experiential diplomatic disputes and negotiations. 3 cr

46.390 Defense and Disarmament

An advanced study of the international security policies currently pursued by the United States, its allies and its adversaries; evaluation and analysis of the criticism of these policies and of the possibilities of achieving disarmament. 3 cr

46.397 Politics and Law of Labor

Consideration of a variety of political, legal and social issues involving labor rela-

tions, unions, employment, and dispute resolution, and their place in American society. 3 cr

46.398 Political Leadership

A study of the political leader as entrepreneur in several different settings. 3 cr

46.399 Judicial Review

An advanced examination of the contemporary controversy over judicial activism. 3 cr

46.401 Research Seminar in Politics

Original investigation using primary sources and secondary literature culminating in the writing of a major paper based on systematic research. Prerequisite: 46.301 Required course for senior Political Science majors AKA: Senior Thesis. Can be taken for "Honors" credit if additional requirements are met 3 cr

Reading Seminars**(46.402 through 46.450)**

Advanced and intensive reading, discussion, analysis, and research in selected areas of political study. Those listed here have been regularly presented. Others may be offered on an occasional basis.

46.404 Reading Seminar in Post-Soviet Politics

Extensive and advanced readings on post-Soviet systems. 3 cr

46.410 Reading Seminar and Instructional Internship in American Politics

Advanced reading and critical analysis in American Politics. Students selected will serve as group project leaders and tutors in association with a large introductory American politics course section. 3 cr

46.415 Reading Seminar and Computer Simulation in Int'l. Studies

Extensive and advanced readings and participation in an intercollegiate computer simulation exercise. 3 cr

46.420 Reading Seminar and Simulation Experience in International Organization

Students take part in a simulation of the proceedings of a regional or international organization, e.g., U.N., O.A.S., O.A.U., or the Arab League. They study all aspects of the selected institution but concentrate on key economic, social and security issues

discussed in the body's debates. The course aims to give the student a clearer understanding of the forces and constraints which shape the foreign policies of individual states. 3 cr

Directed Studies

Directed study courses are available only to Political Science majors and may be elected provided that 1) the material to be covered is not available in any course to be offered in the semester which the directed study is taken, 2) an instructor is willing to undertake the directed study course, and 3) no more than nine credits in the major field are earned in directed study courses.

46.491 Directed Study in Political Science

Directed study offers the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, students define and investigate a research problem in an area of special interest and present the results of their investigation through a combination of readings and papers and/or a significant research paper. Prerequisites: permission of instructor and Chairperson. 3 cr

46.492 Directed Study in International Organizations

Advanced and intensive reading and other activity in connection with the study of selected international organizations. 3 cr

46.493 Directed Study in American Politics

Advanced and intensive reading and other activity in connection with the study of American politics and institutions. 3 cr

46.495 Advanced Tutorial in Politics

A program of directed study in which the advanced student develops an evaluative and critical essay. The purpose is to sharpen and refine techniques for scholarly research and presentation. This course may not be offered in place of the required seminar course. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of the political science faculty and Chairperson. 3 cr

Practicum

One of the following courses is required of all Political Science majors:

46.496 Practicum Experience

A program of study and research for political science majors only stressing involvement in and first-hand knowledge and observation of the political life and relationships of national, state and local institutions. The purpose is to acquaint the student in a directed way with political institutions and political behavior. Specific requirements vary depending upon the nature of the program undertaken by the student. The course will be graded "S" (satisfactory) or "U" (unsatisfactory). 3 cr

46.497 Practicum in the Law

A program of study and research which includes involvement in and first-hand knowledge and observation of the legal system and legal practice. Open only to political science majors and, with certain restrictions, legal studies minors. The course will be graded "S" (satisfactory) or "U" (unsatisfactory). 3 cr

Department of Psychology

Charlotte Mandell, Chairperson

Professors: Meg Bond, Janet Burke, Jon Hellstedt, Kathleen Hulbert, Robert Kunzendorf, Charlotte Mandell, Anne Mulvey, Ronald Pickett

Associate Professors: William Berkowitz, Joan Cannon, David Landrigan, Allyssa McCabe, Charles Nikitopoulos, Gloria Seeman, Richard Siegel, Joseph Waterman

Assistant Professors: Doreen Arcus

Department Location: Mahoney Hall, Room 110

Telephone: (978) 934-3950

The Psychology Department is one of the largest and most active departments in the College and is an especially popular program for those interested in the social sciences. The faculty represent a blend of clinical, developmental, community, and experimental orientations. There is considerable interest in the application of psychological theory and research to global and community issues. The Department offers a major which leads to the Bachelor of Arts degree and also offers a minor area of studies and a specialization in Developmental Disabilities.

Psychology Major

The Psychology major augments the general liberal arts education and provides the basis for graduate training and careers in mental health, education, research and industry. The Psychology curriculum acquaints students with scientific methods and studies and with theoretical foundations in the subfields of psychology (experimental, developmental, social, personality, clinical). It also emphasizes the applications of psychological knowledge and skills in many areas of human functioning. Students are encouraged to become involved in University and community programs and in supervised independent research. Each year the Department offers special awards to graduating seniors who have made outstanding achievements in scholarship, research, community service and leadership. In addition, the department is a member of Psi Chi, the National Honor Society in

Psychology and holds an annual induction ceremony to honor new members.

The major in Psychology consists of at least 33 credits in and no more than 45 credits (with at least 18 credits at the 300 course level or above) and must include the following courses:

1. Each of the following courses:

- 47.101 General Psychology
- 47.260 Human Development I
- 47.269 Research 1: Basics
- 47.369 Research 2: Statistics

2. One course in each of the following three areas:

a. Personality and Abnormal Psychology

- 47.232 Psychology of Personality
- 47.272 Abnormal Psychology

b. Social and Community Psychology

- 47.209 Social Psychology
- 47.255 Community Psychology

c. Experimental Psychology

- 47.276 Theories of Learning
- 47.277 Sensation and Perception
- 47.278 Cognitive Psychology
- 47.373 Brain, Mind & Behavior

3. One Research Laboratory course.

- 47.375 Research 3: Laboratory

4. One Advanced Seminar

- 47.473 Seminar: Social Psychology
- 47.474 Seminar: Developmental Psychology
- 47.475 Seminar: Clinical Psychology
- 47.476 Seminar: Experimental Psychology
- 47.477 Seminar: Contemporary Trends in Psychology

5. One 400-level or above psychology elective

(Seminar, Practicum, Directed Study, Tutorial, Graduate level course)

6. The remaining two to six courses of the major may be elected from any of the course offerings in psychology, with at least 18 credits of the 33-45 required in the major at the 300 level or above.

Students transferring to the college and wishing to major in Psychology must make individual arrangements with the Chair of the Department regarding satisfaction of major requirements. In addition, students wishing to change their major from another college or department at UMass Lowell must have a minimum of 2.200 cumulative average.

Minor Requirements

A minor in psychology consists of 18-24 credits of coursework. At least six credits must be taken in coursework at the 300 level or above in fulfilling the requirements for this minor area.

Specialization in Developmental Disabilities

The Department offers a specialization in Developmental Disabilities to qualified juniors and seniors in Psychology. Students will complete 3 credits of 47.363, Introduction to Developmental Disabilities and four consecutive semesters (12 credits) of Integrative Seminar in Developmental Disabilities, which will include supervised field placements (47.480, 48.481, 59.482, and 59.483). Students seeking further information about the program are urged to consult with the Chair of the Department during their sophomore year.

Master of Arts in Community and Social Psychology

The Department also offers a Master of Arts degree in Community and Social Psychology. For information regarding the objectives and requirements of this graduate program, consult the "Graduate School Catalogue." A combined B.A./M.A. program is available to qualified students. Information regarding this program is available from the coordinator of the Graduate Program.

Sample Course of Study for Psychology

For students entering the University in Fall 1993 and subsequently

Freshman Year

Fall Semester

- 42.101 College Writing I (Gen Ed) 3
92.111 Math Perspectives (Gen Ed) 3

- 47.101 General Psychology 3
Beh & Soc St (Gen Ed) 3
Beginning Language I 3
15

Spring Semester

- 42.102 College Writing II (Gen Ed) 3
Science* (Gen Ed) 3
History (Gen Ed) 3
47.260 Human Development I 3
Beginning Language II 3
15

Sophomore Year

Fall Semester

- 47.269 Research 1: Basics 3
47.2 Personality/Abnormal Elective 3
Literature (Gen Ed) 3
Science* (Gen Ed) 3
Intermediate Language I 3
15

Spring Semester

- 47.2 Soc/Comm Psych Elec 3
47.2 Experimental Psych Elec 3
Aesthetics (Gen Ed) 3
Science* (Gen Ed) 3
Intermediate Language II 3
15

Junior Year

Fall Semester

- 47.369 Research 2: Statistics 3
Beh & Soc St (Gen Ed) 3
Psych or Free Elective 3
Values, C & C (Gen Ed) 3
Elective 3
15

Spring Semester

- 47.375 Research 3: Laboratory 3
300/400 Psych Elective 3
Psych or Free Elective 3
Free Elective 3
Free Elective 3
15

Senior Year

Fall Semester

- 47.4 Advanced Seminar 3
300/400 Psych or Free Elective 3
300/400 Free Elective 3
Free Elective 3
Free Elective 3
15

Spring Semester

- 47.4 Advanced Psychology Elective 3
Psych or Free Elective 3
300/400 Free Elective 3
Free Elective 3
Free Elective 3
15

*Consult the Academic Policies section of this catalogue regarding the General Education requirements for mathematics and sciences.

Psychology Courses(Prefix: 47)

47.101 General Psychology

Intended as an introductory course both for non-concentrators and for concentrators; this course surveys the major areas of psychology: the nature of psychology as a science, principles of learning, the relationship between physiological and psychological processes in humans and animals, sensation and perception, cognitive processes, motivation and emotion, personality and development, adjustment and behavior disorders, and social behavior. 3 cr

47.209 Social Psychology

An introduction to the study of social behavior in interpersonal relationships, groups, organizations, and the community. Topics include attitudes and attitude change, group dynamics, interpersonal influence, and non-verbal communication. 3 cr

47.232 Psychology of Personality

An introduction to the study of human personality including such topics as self-concept, anxiety and adjustment, achievement motivation. Psychoanalytic, humanistic, cognitive, and behavioral theories of personality are stressed with considera-

tion of the interplay between theory and research. 3 cr

47.255 Community Psychology

A survey of the nature and practice of community psychology including principles of community organization and change, as seen in such areas as education, mental health, corrections, and social services. Students participate in field research or practice under the direction of an assigned agency, and classroom work includes discussion of the field experiences of the participants. 3 cr

47.260 Human Development I

The study of childhood and adolescence. The course begins with an overview of major theoretical perspectives, research methods, and ethical issues in human development. Based on a chronological approach, it covers prenatal development and birth, infancy, childhood, adolescence, and the transition to adulthood. 3 cr

47.269 Research 1: Basics

An introductory course concentrating on the basics of scientific research in Psychology. Students will learn: how to acquire information from libraries and the internet; methods for collecting data, such as surveys, case studies, unobtrusive measures and observational procedures, in experimental, quasi-experimental and correlational designs; how to operationalize variables to create reliable and valid measures; to identify types of data and how to describe and graph data; the basics of hypothesis testing and statistical significance; how research is communicated in research reports using APA style. Attention will also be given to ethical issues in research with human and nonhuman subjects. Prerequisite: 47.101 or its equivalent. 3 cr

47.272 Abnormal Psychology

An introduction to the study of various patterns of mental, behavioral, and personality disorder with consideration of issues of diagnosis, etiology, and treatment in terms of contemporary theory, research, and practice. Prerequisite: 47.101 3 cr

47.276 Theories of Learning

Traces the development of theories of learning from earlier global theories to more recent and more specific ones. Behavioral, cognitive and physiological approaches are compared. Current issues

of importance in the study of learning are stressed. Prerequisite: 47.101 3 cr

47.277 Sensation and Perception

Focuses on human sensory and perceptual capacities, and how people know the objects and events of the world through hearing, seeing, smelling, tasting, moving, and touching. In this course, students examine the bases of experiences which correspond to independent measures of the world and the nature of illusory experiences. Prerequisite: 47.101 3 cr

47.278 Cognitive Psychology

Examines the psychological bases of verbal and visual reasoning, logical and creative thought-processes, and linguistic and conceptual behaviors. The nature and limits of knowledge and creative expression are discussed. Prerequisite: 47.101 3 cr

47.312 Learning and Behavior

Based on the principles and findings of experimental studies of animal and human behavior, this course examines various methods and techniques suitable for the modification of human behavior with consideration of how such methods can be used in education, mental health and corrections, and self-directed personal change. Prerequisite: 47.101 3 cr

47.313 Cross-Cultural Perspectives on Women's Lives

This course examines the changing roles and lives of women in contemporary societies. An ecological systems model provides the theoretical foundation for examining how differences between cultures structure women's lives, particularly in terms of health, reproduction, and access to education and employment will be explored. 3 cr

47.322 Gender, Work and Family

This course examines ways that gender is related to contemporary work roles, family roles, and social institutions. Although most women work outside the home and most men have children, the perception that "a woman's place is in the home" and that men are the "family providers" continues to influence personal expectations and social policies. The course will critique current social arrangements and discussion of options for healthier, more equitable alternatives. 3 cr

47.328 Dynamics of Interpersonal Relations

An analysis of psychological dynamics in interpersonal behavior emphasizing such topics as interpersonal communication, self-disclosure, personal styles of interaction, and techniques of change. The primary focus is on the behavior of the students themselves, who are expected to participate in the classroom. The course is taught without a prerequisite but is open only to juniors and seniors. 3 cr

47.332 History of Psychology

Examines the historical roots of psychology from the pre-scientific psychologies of the ancient Greeks to the twentieth century schools of the introspectionists, the Gestalt psychologists, and psychoanalysts. Historical resolutions of recurring issues are contrasted with modern resolutions. Prerequisite: 47.101 3 cr

47.333 Psychology of Consciousness

Introduces students to psychological theories and studies of the mind-body dualism, mind-brain identity, and the emergence of mind. Studies of psychosomatic disease and healing imagery, sleep and hypnosis, "subconscious" perception and "extra sensory" perception, multiple personalities and "split brain" patients are discussed. The questions of animal awareness and computer consciousness are also considered. Prerequisite: 47.101 or 47.278 3 cr

47.335 Psychology and Women

A consideration of such topics as: the psychology of sex differences; biological bases of psychological sex differences; the nature of female sexuality; clinical theory and practice concerning women; women as mental patients and mental health consumers; implications for psychology and for women's status. Taught with no prerequisite but intended primarily for juniors and seniors. 3 cr

47.345 Psychology of Health and Adjustment

An examination of psychological aspects of human health, both physical and mental, and the processes of adjustment and growth. Consideration is given to the interplay of health and illness with emphasis on psychological methods of overcoming and preventing illness and of enhancing physical and emotional well-being. Prerequisite: 47.232 or 47.272 3 cr

47.351 Human Sexuality

The biological, psychosocial and attitudinal aspects of human sexuality are addressed through lectures, discussions, films and from a variety of perspectives. 3 cr

47.352 Psychological Testing

A survey of major tests and techniques used to assess cognitive abilities, personality and vocational interests; an introduction to the various professional settings in which testing and assessment methods are used (e.g., mental health, rehabilitation, employment and personnel selection, criminal justice). Students learn to administer, score, and interpret specific tests and learn how to develop a case study or report based on test data and related information. Prerequisite: 47.101 3cr

47.355 Sport and Exercise Psychology

The course will cover topics such as motivation, arousal and anxiety in performance, performance enhancement, youth sport and family interactions, leadership, cooperation and competition, team cohesion, gender issues, exercise and mental health, and psychological factors in injury prevention and rehabilitation. 3 cr

47.360 Human Development II

Begins with an overview of recent theoretical perspectives on adult development and aging. In chronological sequence, it presents the stages of adulthood and later concludes with death and dying. Topics covered include personal, family, and vocational development through adulthood, gender-pattern differences, and the impact of changing demographics including the lengthening of the life span. Prerequisite: 47.260 3 cr

47.361 Problems and Issues in Childhood and Adolescence

Examines specific disorders during childhood and adolescence including neurotic disorders, autism and psychoses, retardation, learning disabilities and conduct disorders. Consideration is also given to developing an understanding of how parent/child interactions may impair healthy development. (e.g. child abuse, neglect, parental alcohol and substance abuse). Prerequisites: 47.101, 47.260 3 cr

47.363 Introduction to Developmental Disabilities

Presents information about developmental and other disabilities with a focus on men-

tal retardation. Looks at current practices in providing service to people with mental retardation and their families. 3 cr

47.364 Psychology of Crime and Corrections

An investigation of the psychological aspects of crime and deviance and the nature of punishment and rehabilitation. Studies clinical case histories of criminal personalities in conjunction with contemporary psychological theory and research concerning anti-social and delinquent behavior. The nature of prisons, the criminal justice system, and aspects of psychological services, are considered. Prerequisite: 47.101 3 cr

47.365 Psychology of Language

This course explores the human ability to produce and understand language. The course addresses whether, when and how human beings evolved the ability to talk, the major competing theories of language, and issues such as dialect and bilingualism. 3 cr

47.369 Research 2: Statistics

An intermediate level course, required of all psychology majors, focusing on computational statistics and their interpretation. Students will: review types of data and how they are descriptively measured; test hypotheses using t-tests and ANOVA for differences within and between groups, compute measures of correlation; learn the assumptions of parametric tests and how to apply nonparametric analyses; communicate, graph and interpret statistical results using APA format. Students will also be introduced to statistical packages on the computer. Prerequisite: 47.269 or permission of instructor 3 cr

47.373 Brain, Mind and Behavior

A survey of issues and topics dealing with the physiological and evolutionary bases of behavior. Biological systems and processes that influence behavior are considered with particular emphasis on brain mechanisms. Recent discoveries in the neurosciences are presented. Methods of research are reviewed. Prerequisite: 47.101 3 cr

47.375 Research 3: Laboratory

An advanced course, capping the sequence that began with 47.269 and continued with 47.369, in which students will design and carry out one or more empirical research project from start to finish,

resulting in a complete research report using APA style and in an oral "poster session" presentation. The range of possible research topics will vary, reflecting the interests of the instructor. Students will learn to perform literature reviews; formulate a research question; operationalize variables; develop research designs; obtain ethical review and approval; and collect and analyze data. Prerequisites: 47.269, 47.369, and 47.276 or 47.277 or 47.278 or 47.373 4 cr

Advanced Seminars

Every Psychology major must take at least one advanced undergraduate seminar. The following 400 level seminars are designed primarily for upperclass majors in Psychology, and any may be used to satisfy the 400 level requirement (six credits) of the concentration. They all carry prerequisites and involve a high degree of independent work in field experience and/or research. Emphasis is on current developments in specialized areas of psychology reflecting the expertise of members of the faculty. The descriptions provided below should be considered only in general terms: seminars are highly individualized and vary considerably in content and approach from one instructor to another. Each semester the Department will post notices providing more detailed descriptions, and students are urged to utilize this information in making their selections. Seminar enrollments will be strictly limited, and a high degree of student participation is expected. Each year at least one specific seminar in each of the general areas will be offered. Students may enroll for as many different seminars as they wish, including as many as two seminars in the same general area, provided only that no seminars taken for credit cover the same specific topics.

47.473 Seminar in Social Psychology
Intensive study of one or more of the following special topics in social psychology: small group interaction; social aspects of health and illness; conformity; attitude formation and prejudice; patterns of communication, including non-verbal communication; psychology of sex roles; methods of social action and social change in the community. Prerequisites: 47.269, 47.209 3 cr

47.474 Seminar in Developmental Psychology

Careful consideration of selected topics in the area of human development including, but not limited to, the following: psychology of the family, parent-child relations, infant development, adjustment during adulthood, death, dying, etc. Prerequisites: 47.269, 47.260 3 cr

47.475 Seminar in Clinical Psychology

Focuses on such topics as the following: the nature of psychotherapy and clinical practice, analysis of specific clinical theories of psychopathology and psychotherapy (family systems, Gestalt, behavioral, psychoanalysis), the nature and causes of specific psychological disorders (schizophrenia, affective disorders, etc.), the nature of mental hospitals, the community mental health movement, clinical methods of assessment, current topics in personality theory and research, etc. Placement may be required. Prerequisites: 47.269 and 47.232 or 47.272 3 cr

47.476 Seminar in Experimental Psychology

Intensive study of specific topics and areas of psychological research from among the following: the experimental analysis of behavior, sensation and perception, cognitive psychology, the biology of behavior, the comparative study of animal behavior, and other selected topics related to experimental psychology. Prerequisite: 47.269; other prerequisites may be specified by the instructor. 3 cr

47.477 Seminar: Contemporary Trends in Psychology

Will be offered from time to time, and deals with issues in contemporary areas of psychological practice and/or research; implications for future developments in the field will be covered. Prerequisite: 47.269; other prerequisites may be specified by the instructor. 3 cr

47.480 Integrative Seminar in Developmental Disabilities I: Entering the Lives of People with Developmental Disabilities

This seminar provides for an in-depth exploration of values, and attitudes of participant. It also offers students the chance to expand their capacities for deepening their identity with people with developmental disabilities and for investigating

the practice of disenfranchisement. Finally, it provides a forum for discussion of and reflections on their fieldwork experience. (Field placement required) Restricted to Development Disabilities Program 3 cr

47.485 Peer-tutoring in Psychology

This course provides an opportunity for qualified students to serve as peer tutors in selected courses. May not be counted as one of the required 400-level courses. 3 cr

Directed Study

Directed studies are available only to Psychology majors and may be elected provided that 1) the material to be covered is not available in any course offered during the semester in which a directed studies/advanced tutorial is contemplated, 2) instructors are willing to undertake the supervision of the student's work, and 3) no more than nine credits in the major are acquired in directed studies/advanced tutorials.

Directed studies offer a student the opportunity to engage in an independent study or research project during an academic semester under the supervision of a department member. The topic for such work will be jointly determined by the student and his/her supervisor. Interested students are advised to examine the list of department members and their specialized fields of interest, and students must obtain approval of a faculty member to supervise a directed student before they can register for it. Although no prerequisites have been set, it is expected that the student will approach this study with the basic theory and the academic and technical skills essential in high level work, and ordinarily only juniors or seniors will be considered.

47.491 Directed Study in Psychology

Through frequent consultation with the instructor, the student carries out the investigation of a particularly specialized area of interest. One semester of directed studies may be counted toward satisfaction of the second 400 level requirement of the major. 3 cr

47.495 Advanced Tutorial in Psychology

An opportunity for the student to work at the highest level of specialization and independence on a project of his or her

own design. Requires careful consultation with the faculty. May be counted toward satisfaction of the second 400 level requirement of the major. Prerequisite: 47.491 3 cr

Practicum**47.496 Practicum in Psychology**

A program of practical experience for Psychology majors only. Specific requirements vary, but the Practicum experience enables upperclass students to work and study in a variety of areas related to psychological practice and research (mental health agencies, hospitals, prisons, schools, University programs, etc.). Practicum may be repeated for a maximum of nine credits. Students are rated "satisfactory" or "unsatisfactory". Prerequisite: permission of the department or designated faculty member, which must be obtained before registration the semester in which the Practicum is to be taken. May be counted toward satisfaction of the second 400 level requirement of the major. 3 cr

Community and Social Psychology Graduate Courses

For graduate courses in Community and Social Psychology, consult the "Graduate School Catalogue"

Department of Regional Economic and Social Development

John Wooding, Chairperson

Professors: Dean Bergeron, William Lazonick, John MacDougall, Arlene McCormack, Philip Moss, Jean Pyle, Linda Silka, Chris Tilly, John Wooding

Associate Professors: Robert Forrant, Laurence Gross, Sarah Kuhn, William Mass

Department Location: O'Leary Library, Room 500

Telephone: (978) 934-2900

The Department of Regional Economic and Social Development was formed in 1997. Currently, the department does not grant an undergraduate major, but does offer several undergraduate courses. Many of the graduate courses are also open to advanced undergraduates. Juniors and Seniors are eligible to apply for admission into the joint B.A./M.A. degree program in Regional Economic and Social Development. Students must be University of Massachusetts Lowell undergraduates in good standing. Applicants must have an undergraduate grade point average of 3.0 or better (on a 4.0 scale).

No examination test scores such as the Graduate Record Examination Aptitude Test, GMAT, or any Graduate Achievement tests are required to be included with the application.

The department offers an interdisciplinary program that unites development theories with practice by integrating classroom learning and research with regional, national, and international economic and social development projects and research in which the faculty are engaged. Courses are taught in an interdisciplinary manner, with faculty trained in economics, history,

planning, political science, psychology and sociology.

The program prepares students to assume professional roles involving research, consulting, and strategic planning in business, in local, state, national, and international development and planning agencies, and in nonprofit organizations working on economic and social development. Students, if they choose to continue their education, will be prepared to continue matriculation in a wide variety of Ph.D. programs in the sciences, social sciences and humanities, including management and public policy.

Undergraduate Courses

57.201 Regions: Merrimack Valley

The ways people produce, distribute, and consume the world's resources profoundly influence the problems we experience in this and other regions of the world.

Problems occur most particularly in the areas of work, community, and environment. The goal of this interdisciplinary course is to explore such regional problems and possible solutions within national and global contexts, as well as historical. In the area of work, we will discuss what is necessary to create good jobs, characterized by decent pay and benefits, worker involvement in decision making, and healthy workplaces free from discrimination. In the area of community, we will address such things as patterns of immigration and the interactions between community stability and institutions such as education, family, political leadership, and religion. In the area of environment, we will explore issues surrounding the reduction of pollution that infects our communities and living spaces (e.g., the tradeoff between environmental improvement and economic growth). The course will stress experiential learning (via field trips and small group activities) and will include films as well as readings and presentations from various disciplines. (General Education Course (BS))

3 cr

57.210 Island Economies

This course will examine the economies and social structures of selected islands. We explore the quite distinct ways in which these islands have developed, and we will undertake a comparative analysis

of the paths to development that each nation has employed. This course utilizes books, articles, Internet resources, first-hand accounts of life in the countries, guest speakers, videos, and music as we seek to answer several questions. What social and economic factors help explain the economies of these countries? How can small islands develop in the face of large global events? What kinds of jobs and industries are in each country? What have the roles of women been in the social and economic development process? How much has foreign investment influenced the development process? What has happened to the environment during the development process? Why have individuals emigrated from these countries and how has this affected society? What role has the government played in the development process? How does culture affect development?

3 cr

57.211 Production and Sustainable Development

This course examines workplace and regional factors that shape the prospects for sustainable prosperity and worker and community empowerment. The course begins by reviewing recent trends in the distribution of income and wealth and the industrial structure of the New England economy. The historical dynamics shaping work organization and regional development are examined. Several industry case studies are selected because of their importance to the regional and national economy. The case studies provide focus for studying the strategic choices made by firms in mature industries and newly emerging regions; the basis of competitive advantage for Japanese firms and the response of American rivals; and the influence of the product cycle and regional institutions on capture or retention of emerging and mature industries. The final section of the course focuses on the prospects for sustainability of the organization of production and its environmental impact, incentives for skill development and technological innovation, and shared prosperity. A central course objective is to foster an understanding of the links between the workplace and region in the pursuit of sustainable development and shared prosperity.

3 cr

57.218 Regional Health and Environment

Many health problems require broader based interventions than can be offered in a clinical setting alone. Such problems include the many health issues related to environmental causes (both in the workplace and at home). This course explores such regional health issues as well as the social, political and economic factors related to societies intervening to ensure a sustainable environment. A sustainable environment is one that does not threaten the well being of future generations. In this course, student groups will choose a global region, and will research a selected environmental health problem relevant to the modern environmental health movement for countries in their region. Using this research, students will prepare a working paper about the social, economic and political factors that are influencing, or are being influenced by, this environmental health problem. These working papers will be the basis for classroom debate among student groups representing these various regions, as well as for the development of resolutions dealing with solutions to regional environmental health issues. 3 cr

57.301 Business, Society and Public Policy

Every business functions within a market: it purchases some goods and services, sells other goods and services, and does its best to make a profit. But that's not all. Every business also functions within a society—and comes into constant contact with that society's laws, beliefs, and expectations. Government is not simply a source of "red tape;" it is the representative, for better or for worse, of society's norms and aspirations. Government also helps to create the conditions that make industrial competition possible. Companies count on government to provide certain needs, such as an educated workforce, highways, and a policy on foreign trade. Businesses also face a set of obligations in areas such as pollution, discrimination, and consumer safety—and those who do not comply may find themselves under pressure from regulators, courts, consumers, or employees. This course examines the interfaces between business and society, focusing particularly on public policy and the role of government. What can and should governments

(federal, state, local) do to strengthen the efficiency and competitiveness of U.S. industry? What is an appropriate set of requirements for corporate "good citizenship?" How should policy-makers react to a changing economic environment—and how should businesses react to a changing set of policies? We attempt to address these questions in ways that will be useful to students as participants in the world of business, as members of government or non-profit agencies, or simply as citizens of a society where business and government are key players. We will look at theoretical and historical perspectives on these questions. Much of the course is built around large and small case studies of companies as diverse as General Electric, Ocean Spray, Malden Mills and Texaco, as well as case studies of specific policies. The topics extend from cigarette smoking to international trade policy. 3 cr

57.353 Managing Workforce Diversity

The purpose of this course is to help students to become more effective and sensitive employee or manager in an increasingly diverse workplace. Whether you are in the majority or the minority in a given setting, this course will help you evaluate the situation and will lay the groundwork for effective action. A student who successfully completes this course will be able to evaluate a written description of a diversity initiative in a corporate setting, take action that is sensitive to individual differences and group tendencies, and apply an in-depth interviewing technique that not only develops the capacity to do research, but develops important life skills. 3 cr

57.400 Comparative Industrial Revolutions

Much of the news we read today refers constantly to the new technology, to globalization, to the information revolution, to the new workplace. While our world is very different from the world of 20 years ago, and enormously different from the world of 150 years ago, during those times people also spoke of the new technology and the new workplace—especially as the industrial revolution took hold, first in Britain, a little later in the United States. To figure out what is going on in the world it is important that we know something about how we got here from there. To do so means we need to

understand what went on during the astonishing changes that occurred in the nineteenth century: what happened work? To workers? To communities? To villages, cities and towns? To ideas and to values? In this course we will compare the experience of Britain and the United States as they underwent the industrial revolution, and swept in the dawn of modern capitalism. We will seek to relate these rich histories to current events and current experience by looking particularly at the lives of those most profoundly changed by unprecedented technological, economic, and political developments. 3 cr

57.491 Directed Studies: RESD 3 cr

57.493 Practicum in RESD 3 cr

57.495 Research Seminar: RESD 3 cr

Graduate Courses**57.502 Society, Technology & Work 1820-1920**

This course surveys issues of work organization and technological change as they evolve through the interaction of workers and owners. Contrasts are presented between different systems of production, key changes in the work roles and responsibilities of shopfloor workers, foremen, managers, and owners are identified. This course includes comparisons of historical transformations at key moments in the emergence of American industry. It focuses on issues of the location of skill and control of the workplace, the role of government, and impacts on various facets of society. Race, gender, and immigration are also prominent. Class participation and student projects play a major role. 3 cr

57.503 Work, Technology & Training

This course surveys issues of work organization and technological change and the key roles they play in the development process. Contrasts are made among different systems of production, and key changes in the work roles and responsibilities of non-supervisory employees, front line supervisors and middle and upper management are identified. This course includes comparisons of historical transformations at key moments in the emergence of internationally competitive developed economies. In addition, selected contemporary cases exemplify current issues

in the ongoing transformation of work organization and technology. Students are introduced to practical considerations in work process design. Student projects are required. Permission of Instructor 3 cr

57.504 Gender Differences At Work

This team-taught course explores differences in women's and men's work in both the paid and unpaid labor force, including the household. Issues covered include differences in labor force participation, occupations, earnings, career ladders, health and safety, and technology. The major explanations offered by social scientists for the inequalities will be examined for their relevance. Strategies for change will be explored. The importance of class, ethnic/racial, and native-born versus immigrant status is fully integrated throughout the course. This course is designed to be relevant for both graduate students and upper-level undergraduates in a variety of disciplines. 3 cr

57.505 Social Movements And Empowerment

This course focuses on ways in which non-elite groups and individuals can gain control over important aspects of economic and social development. These aspects include decisions about such matters as industrial location, work conditions, community services and environmental protection; and the status of women, ethnic/racial minorities and other disadvantaged groups. Special attention is paid to the dynamics and potential impact of grass-roots social movements. 3 cr

57.506 Research Methods In Economic And Social Development

This course is an applied survey of research methods appropriate for regional economic and social development. Students will learn data presentation and basic descriptive statistics, as well as basics of researching data sources and primary data-gathering techniques (survey, case study, archival), and a framework for deciding when particular methods of data-gathering and analysis are appropriate. Students will apply the techniques as they learn them. Permission of Instructor 3 cr

57.507 Municipal Management

This course will cover a broad range of municipal issues including municipal finance, economic development, public safety, municipal operations, personnel

management, the press and the media. The role of local, state and federal government partnerships are studied. Several class exercises require students to role-play the public administrator in his/her role in the public process. The case study method will be used. The City of Lowell will be used as the urban laboratory, however none of the case stories are about Lowell. 3 cr

57.508 Community Based Planning

This course develops the theory and practice of participatory planning for development, particularly at the community level. Students will learn the basic steps of planning, including goal setting, prioritization, strategy development, and implementation. The roles of public sector, nonprofit and private sector organizations in the planning process will be analyzed. The course will include case studies from a diverse set of communities, including some international examples. 3 cr

57.509 Environmental Law & Policy

This course evaluates the development of environmental policy over the past forty years. It evaluates specific statutes enacted by the Congress and how they work at the state and local level. The course also critiques policy and law developments and studies emerging trends in environmental law. 3 cr

57.510 Public and Development Finance

This course provides an introduction to the theory and practice of investment finance in the private and public sectors, emphasizing concepts and tools that are useful to practitioners interested in economic development. The differences between the goals of finance and investment in the private and public sectors will be presented along with an overview of financial mediation. Methods of corporate finance, including markets for debt, equity, options and futures will be introduced. Capital market imperfections that affect the economic development will also be analyzed along with methods of financing public investment and the connections between public and private finance and investment. Cases of local and regional development financial tools such as revolving loan funds, private and public venture capital funds, loan guarantee programs, and the experience of the Community Reinvestment Act will be studied.

Prerequisite: Foundations of Comparative Regional Development 3 cr

57.511 Dynamics of Power and Authority

This course surveys theories of power, authority, participation, and politics. Building on these theories, students will examine changing social, political, and economic patterns of inequality based on class, race (and related divisions of ethnicity, religion, caste, nationality), and gender. Reviews various approaches to altering these dynamics (business strategy, public policy, community and social movements). Cuts across units of firm, community, region, and nation, along with corresponding governmental institutions, and links theoretical analysis with study of practical problem solving. Instructor-initiated cases drawn from a variety of national experiences. Students will learn techniques of power analysis and prepare a power analysis project. 3 cr

57.512 Community Conflict Resolution

This course gives students an understanding of the main issues and solutions involved in community level conflict resolution, paying special attention to the Merrimack Valley. It develops students' skills in practicing conflict resolution and/or evaluating programs in the field. 3 cr

57.513 Foundations of Comparative Regional Development

This course offers an initial grounding in economic, historical, political, and sociological methodologies and introduces discipline-based and interdisciplinary approaches to regional development. It introduces students to: identifying and assessing structural factors influencing regional development, defining regional development challenges, and generating problem-solving strategies and public policies. The course highlights the relationship between theory and application, and looks at development at the community, national, and international levels. It makes extensive use of case materials on regional development, including a unit on the development of the Massachusetts economy. Students will learn how to find, prepare and analyze data on regional economies and will learn several basic quantitative tools for regional analysis. 3 cr

57.514 Community Mapping

Interest in community mapping as a way to identify, analyze, and address problems is growing as new computer tools become available. This course provides students with hands-on training in using geographic information systems (GIS) for research, problem solving, and social action.

Students will read the interdisciplinary literature that shows how scholars from such fields as regional economic and social development, public policy, community psychology, management, environmental sciences, health care, and criminal justice are using GIS to explore questions and work with different constituencies. Students will learn about how people in different jobs (in government, industry, nonprofits) are employing community mapping in innovative ways for grant writing, needs assessment, strategic planning, evaluation, and as a way to identify and address inequities. At the completion of the course, students will be adept at using GIS programs applying the technology to problems of their choice. 3 cr

57.515 Politics and Economics of Public Policy

The course will provide students with both a set of analytical frameworks to understand how and why specific public policies develop, and a set of normative perspectives to assess what makes for good public policy. Our treatment will be interdisciplinary drawing from areas of economics and political science.

Following some grounding in the political economy of the role of government and policy making in a market based economy such as the United States, we will do case studies to understand and to evaluate policies from a variety of current areas of interest to the students and professors. Students will be introduced to basic ideas of cost benefit analysis, program evaluation, and implementation analysis. 3 cr

57.517 Development and International Competition

Global perspectives drive this examination of competitive advantage as reflected, first and foremost in manufacturing organizations at the aggregate economy, industry, company, and production unit levels. The relationships between private and public policies at both the national and regional levels that affect economic development will be examined. Student projects and

practica will utilize concepts presented in this course on the theory of the innovative firm, organizational integration and network economies, financial commitment and strategic decisions, and sustainable development. 3 cr

57.518 Comparative Environmental Studies

As we go into the 21st century, predictions are that environmentally related health problems will become more prominent and put additional stress on industrial, as well as transitional and developing nations. It is widely recognized among participants of the modern environmental health movement that broad based interventions, and particularly those on the community level, can defray increasing the environmental deficit.

In this course, students will explore the dynamics and interactions of social, economic and political factors that aid or impede a community's ability to contribute to global environmental sustainability. One that does not threaten the well being of future generation. Students will each select a city from one of six developing regions (Latin America, China, Southeast Asia, India and South Asia, Sub-Saharan Africa, and North Africa & the Middle East), a city from one of two transitional regions (Russia and Eastern Europe), and a city from an industrial region (the New England area of the United States) of similar population size. Using information from government documents and other library resources, personal contacts, as well as the World Wide Web sites which use maps and geographic information systems (GIS) to explore environmental health issues, students will research the status of environmental sustainability for each of their 3 chosen regions. At the conclusion of the course students will present a comparison of their 3 regions. 3 cr

57.520 Inequality, Organization and Development

Despite the lowest unemployment rate in 25 years, the economic recovery of the 1990s has brought a 'Treadmill Economy' not running faster with minimal gain. With low productivity growth, surprisingly little growth in wages and a long-term slowdown in economic growth since the 1970s, the United States continues to experience increasing inequality. What forces are at

work shaping these trends and can they be modified or reversed on the local, state and regional levels? How have these trends both shaped and been influenced by social and business policies concerning poverty and welfare, local and urban development, technology and economic development, changes in work organization and labor-management relations, domestic investment and international competition? This seminar course will bring local and national experts on these issues to present their findings and discuss their view of future prospects for local and regional social and economic development policy. 3 cr

57.521 Software Design in Context

A graduate level introduction to selected social, organizational, ethical, and policy perspectives on information technology. Through reading and discussion of both theoretical and applied material on software development and computerization, students will gain an interdisciplinary exposure to the context of computer technology. 3 cr

57.537 Developing Economies

This course explores alternative visions of what is meant by development, what is involved in the development process, and who benefits from it. A country must choose the goals (such as growth, equity, or sustainable human development) it hopes to achieve and develop a strategy for attaining them. It must make critical decisions regarding the roles of major sectors of the economy (agriculture, industry, services, the extent of foreign involvement), the form of organization they will have (large or small scale, centralized or decentralized, private or public ownership), and the roles of major institutions (government, financial sectors, multinational corporations, and international aid agencies). The theoretical and practical issues we will discuss have broad relevance for understanding the varied development process in Asian countries, the struggles of middle-level developing countries (such as Mexico or Brazil) or the despair of the broad group of countries for which development seems an increasingly dimmer vision (many African countries). The course emphasizes interconnections in the world economy. On the one hand, policies shaped by institutions in First World or industrialized countries have a

significant and often adverse impact on developing countries. On the other hand, the failure of development programs in many countries thought to be 'developing' has a critical impact on the future of industrialized nations. Students will be expected to develop thoughtful positions on current controversial issues in development and to suggest appropriate strategies for change. 3 cr

57.591 Directed Study in Economic and Social Development

Permission of Instructor 3 cr

57.598 Organizational Dynamics & Regional Development

This course presents theory and practice of how to develop organizations capable of learning, innovating, and empowering their participants. Case studies will focus on challenges and opportunities posed to contemporary organizations and institutions engaged in economic development. These cases will be drawn from, and principles will be applicable to, for-profit businesses, public and nonprofit agencies, and voluntary organizations. This course will also examine the nature of interactions among these various types of organizations and institutions within a variety of social and historical settings. 3 cr

57.691 Practicum in Economic and Social Development

Permission of Instructor 3 cr

57.712 Thesis/Project/Practicum Preparation Workshop

This workshop prepares students to undertake a thesis, practicum or project. Working with the professor, each student identifies a feasible research question or project/practicum, identifies data sources and methods, conducts a literature review, chooses an advisor, and writes and revises a thesis proposal or project/practicum proposal. (Prerequisites: Foundations; Dynamics of Power and Authority; Work, Technology and Development; Organizational Dynamics; and Research Methods. Permission of Instructor 3 cr

57.733 Masters Project (Graduate Students Only)

57.746 Masters Thesis (Graduate Students Only)

Department of Sociology

Carol Brown, Chairperson

Professors: Levon Chorbajian, Mitra Das, Nancy Kleniewski, Shirley Kolack (Emerita)

Associate Professors: Carol Brown

Assistant Professors: Daniel Egan, Kristin Esterberg

Affiliated Faculty: John MacDougall, Arlene McCormack, Frederick Sperounis

Department Location: Coburn Hall, 114

Telephone: (978) 934-4306

The Sociology Department provides a solid foundation in sociological knowledge, theory, and methodology. Its graduates are well-informed citizens who often continue graduate or professional studies, pursuing careers in law, health-care and teaching, as well as traditional opportunities in the social services.

The Department of Sociology offers a major leading to the B. A. degree and a minor area of studies.

Sociology Major

The major in Sociology offers students the opportunity to understand the nature of social life in our own and other societies. It provides a unique perspective from which to gain a systematic view of material in a large number of different fields. Courses in the Department encompass such topics as ethnic cultures, the dynamics of social policy, relationships between sexes, the nature of industrial capitalism, and the impact of technology on modern society. Students are encouraged to do work in the Lowell area as part of the sociology program. A prevalent value within the Department is the search for meaningful social change. Students who are interested in working in human services, personnel management, urban planning, elder services, communications, law, teaching or full-time academic work might consider a major in Sociology.

Summary of Degree Requirements

University General Education Requirements

Sociology majors entering in Fall 1993 and after must conform to the new University General Education Requirements outlined in the appropriate section of this document.

Note: Courses taken to satisfy the requirements of a major or minor cannot be used to fulfill core requirements.

Major Field Requirements (36-45 credits)

Effective with the class of 1995 (entering the University in September 1991) and all subsequent classes, Sociology majors must fulfill the following requirements:

48.101 Introduction to Sociology OR
48.102 Introduction to Social Anthropology

48.321 Social Theory I

48.322 Social Theory II

48.402 Sociological Research I

48.403 Sociological Research II

48.4xx One other 400 level course excluding 48.496 Practicum

In addition, majors must complete at least 6 credits (two department courses) at the 300 level or above.

Between 12 and 21 credits (four to seven courses) in sociology may be completed at any level.

Note: Students entering before September 1991 are not required to take 48.322 or 48.403 (30-45 credits)

The maximum number of directed studies, theses and/or practica is 12 credits.

Language Requirement

Sociology majors are required to evidence intermediate language proficiency and must satisfy this requirement by conforming to the guidelines outlined in the appropriate section of this document.

Note: Courses taken to satisfy the language requirement cannot be used to fulfill University General Education Requirements.

Unrestricted General Electives

Within the guidelines outlined in the appropriate section of this document, Sociology majors are required to complete their minimum total credit requirements for the degree in sociology (120 credits) by electing courses in other university academic departments.

Concentrations

Sociology majors may choose a concentration of study from the options below. Students will take four courses in their area of concentration, one of which should be a seminar or a field placement for the human services concentration. Students can choose a thesis option as part of the concentration. A non-sociology course can be substituted for one course within the concentration with the permission of the Department Chair and the course instructor. Non-sociology courses cannot be used for the general major (i.e., without a concentration).

Concentration Options

- a. Human Services: Sociology of Deviance, Sociology of Law, Sociology of Health, Sociology of Family, The Study of Minorities, Social Services, Field Placement.
- b. Peace and Conflict: Sociology of Non-Violence, Social Stratification, Study of Minorities, Women in Society, Social Movements, Peacemaking Alternatives, Human Rights, Seminar on Peace, Violence and War
- c. Gender and Family: Sociology of the Family, Introduction to Gender Studies, Sociology of Family Law, Sociology of Reproductive Technology, Women in Society, Seminar on the Family, Introduction to Social Values
- d. Social Change and Inequality: Intro to Social Values, The Study of Minorities, Social Deviance, Political Sociology, Social Stratification, Urban Sociology, Sociology of Non-violence, Sociology of Law, Social Movements, Seminar on Peace, Violence and War, Seminar in Class Status and Power

Thesis Option

This involves advanced reading, research and analysis in selected topics in sociology. Students taking this option are strongly advised to do so in the fall semester of the senior year. No more than six credits can be taken for thesis. There will be two readers for the thesis, one of whom will be the thesis advisor. Students will be asked to defend the thesis.

Transfer Students

Students transferring to the College and wishing to major in Sociology must make individual arrangements with the Department Chairperson regarding satisfaction of major course requirements.

Sociology Minor

A minor area of study consists of 18-24 credits of coursework in sociology. At least six credits must be taken in coursework at the 300 level or above.

Sample Course of Study for Sociology

For students entering the University in Fall 1993 and subsequently

Beginning with the class of 1995 (freshmen entering the college in the Fall of 1991), a major in sociology consists of 36 to 45 credits with at least 21 credits at the 300 level or above (includes required and elective courses) in the major.

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Mathematics* (Gen Ed)	3
48.101/102	Introduction to Sociology/Social Anthropology	3
	Beh & Soc St (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3

48.	Sociology or Free Elective	3
	Beginning Language II	3
		15

Sophomore Year**Fall Semester**

48.2	Sociology Elective	3
48.	Sociology or Free Elective	3
	Beh & Soc St (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

48.321	Social Theory I	3
48.	Sociology or Free Elective	3
	Literature (Gen Ed)	3
	Values, C & C (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year**Fall Semester**

48.402	Sociological Research I	3
48.322	Social Theory II	3
	Science* (Gen Ed)	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

48.403	Sociological Research II	3
300/400	Sociology Elective	3
300/400	Sociology Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year**Fall Semester**

300/400	Sociology Elective	3
300/400	Sociology Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

48.	Sociology Elective	3
48.4	Sociology Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policy section of this catalogue for the General Education requirements for mathematics and sciences.

**for class of 1995 and beyond

Sociology Courses (Prefix: 48)**48.101 Intro to Sociology**

Basic course in sociology. Emphasis is directed at the ways in which social institutions such as government, schools, the economy, social class, and the family develop and influence our lives. It is concerned not only with presenting various ways to understand our relationship to society but also with ways to change it. Prerequisite to all 300 and 400 level sociology courses 3 cr

48.110 Intro to Social Values

A sociological analysis of belief systems in contemporary United States. The different perspectives held by social groups are shown, and students are encouraged to examine their own perspectives. The role of churches, governments and families in conserving and changing the social structure of modern society are examined. Beliefs are related to political and economic interests and conflicts. Historical and international comparisons are made. 3 cr

48.102 Social Anthropology

Using the comparative approach to society, this course examines several distinct cultures as a means of understanding both the universal constants and the variations in human societies. 3 cr

48.212 Cultures of the World

Focuses on a different country or region each time it is given. Students examine the traditional culture, recent history, economic development, class structure and international relations of the area covered. See the Department Chairperson for specifics 3 cr

48.215 Peacemaking Alternatives

Examines various positive alternatives to war and violence, including disarmament, nonviolence, conflict resolution, and the United Nations. Students do volunteer work with an activist agency or interview an activist. The course stresses the historical and contemporary role of peace movements and allied social-change movements such as feminism, civil rights and environmentalism. 3 cr

48.231 Sociology of the Family

Study of the nature of the family in contemporary society with particular emphasis on the family in America. What functions does the family perform in modern society? How is it changing? How do these changes affect our lives? 3 cr

48.234 The Study of Minorities

Examines the process of immigration and majority-minority relations in the United States over the last century with particular emphasis on the process of adaptation in a pluralistic society. The treatment of minority groups in other societies is examined as well. 3 cr

48.240 Introduction to Gender Studies

This course is an interdisciplinary introduction to the field of gender studies. A variety of topics are presented, such as gender stratification, work and family, sexual identities, media representations of women and men, women's movement, and violence against women. Feminist theories and methods are also introduced. 3 cr

48.251 Community Service

Course uses field work approach to understand social problems and to discipline study and career pursuit in the area of public service. 3 cr

48.255 Sociology of Deviance

Analysis of how social institutions define and respond to various forms of social deviance, from individual mental illness to gang violence to illegal acts by governments and corporations. Attention will be paid to the construction and management of deviant identities, the role played by social status, and the social importance of institutions of social control. 3 cr

48.256 Political Sociology

Focuses on the development and use of power in modern society. Emphasis is placed on the relationship of American political institutions to economic institu-

tions, to social class, and to supporting ideologies. 3 cr

48.260 Mass Media & Communications

Course investigates the structure of mass communications and the impact of the media on our lives. A full range of media are considered including television, radio, cinema, and the press. The potential impact of new media sources are also considered. 3 cr

48.270 Self and Society

An examination of the relationship between individuals and the social world around them. The course examines the underlying structures that pattern human interaction. Topics include the social construction of the self, the construction of social reality, and the sociology of emotions, among others. 3 cr

48.303 Sociology of American Education

Course introduces students to ongoing debates in the field of Sociology regarding the American educational system, its structures and functions and how it relates to issues of inequality by race, class and gender. Students are expected to explore, examine and evaluate the current issues relating to the system of education in the United States. 3 cr

48.305 Sociology of Family Law

Examines some social issues in family law, the changes therein and the social climate and consequences accompanying these. By using the sociological method of enquiry to examine family law cases, the relationship between law and society as instruments of order and change are exemplified. 3 cr

48.310 Ethnicity in Massachusetts

This is an interdisciplinary, distance learning course devoted to understanding specific ethnic groups in Massachusetts, their histories and cultures, and the economic and political realities of their lives as defined by themselves and others. Different groups are studied each year. Groups such as African American, Puerto Rican, Cambodian, Vietnamese, Wampanoag and Mi'kmaq will be examined in relation to the topics listed above. 3 cr

48.317 Sociology of Genocide

The deliberate destruction of an ethnic group is an historical event and a social

process. This course addresses such questions as: Why do genocides occur? Why do people become genocide perpetrators? How do genocides affect survivors and their offspring? How can genocide be prevented? Focus is on Native American, Armenian and Jewish experiences and recent cases of ethnic cleansing. 3 cr

48.321 Social Theory I

Examines major sociological theories, both historic and contemporary. Students learn how theory is created, and how it is linked to facts. Prerequisites: 48.101, plus one other sociology course 3 cr

48.322 Social Theory II

An in-depth critical examination of major theorists in sociology. Students learn about their impact on the development of existing social thought. Prerequisite: 48.321 for non-majors. Prerequisite for majors: 48.321 3 cr

48.331 Sociology of Reproductive Technology

In vitro fertilization, artificial insemination, surrogate motherhood, genetic engineering, birth control, childbirth are issues examined. Social attitudes towards women and reproductive rights are included. Prerequisites: 48.101 and two sociology or two women's study. 3 cr

48.341 Social Stratification

Focuses on the phenomenon of social class distinctions with particular emphasis on social class in America. The approach is both historical and sociological. 3 cr

48.345 Urban Sociology

Deals with issues related to the quality of life in American cities. Students taking this course may engage in research projects on the city of Lowell and the role of the University of Massachusetts Lowell within that city. 3 cr

48.350 Social Service

An examination of the structure of social welfare services in America. Attention is directed at the functions that welfare and mental health institutions serve in American society; the attitudes and values that surround these institutions; and the role of the social worker within them. 3 cr

48.351 The Sociology of Health and Health Care

A historical and contemporary study of the socio-politics of health, illness, and the health care industry in the United States.

Attention is given to providers, consumers, owners, workers, and professionals in terms of their power, class, race, sex, and age. Reforms and alternatives are considered. 3 cr

48.352 Sociology of Non-Violence

An analysis of non-violent efforts to achieve social change through demonstrations, civil disobedience, etc. Movements led by Mahatma Gandhi, Martin Luther King, Jr., and others are examined. 3 cr

48.357 The Sociology of Religion

An investigation of religious institutions and experiences. Emphasis is placed on the influence of religion on social change. 3 cr

48.361 Sociology of Law

The course examines the role of social forces in defining the law. Topics include the legal profession, white-collar crime, and the importance of race, class and gender in the criminal justice system. 3 cr

48.370 Women in Society

This course seeks an understanding of women's diverse positions in culture, the economy, the family and political life. The course focuses on women's commonalities and differences as well as women's attempts to organize for social change. 3 cr

48.382 Social Movements

Considers organized action undertaken to alter the social position of a group. Organization, techniques of action, motivation of participants, and group ideologies are studied. Materials from historical, social, psychological, and sociological sources are used. 3 cr

48.388 Seminar on Industrial Lowell

The seminar analyzes and discusses the growth, decline and rebirth of Lowell, Massachusetts. Special attention is given to shifts in technology and changes in work relationships, e.g., from farm women to immigrant labor force to high technology. Lowell's rich past and present is observed first hand by using the city as a laboratory. 3 cr

Advanced Sociology Courses

The following courses are intended primarily for upper-class majors. Students need a minimum of four courses in sociology, including 48.101, before enrolling in these classes. Contact the Department

Chairperson or instructor for more information.

48.402 Sociological Research I

An introduction to methods of social research, with emphasis on quantitative research methods. Presents basic statistical techniques used in social research as well as the computer software used for analyzing social science data. For majors only. 3 cr

48.403 Sociological Research II

Qualitative research methods. Discusses various strategies employed by qualitative researchers with special emphasis on field research. For majors only. 3 cr

48.404 Field Placement

Provides students with the opportunity to directly observe and participate in the operation of a social service organization. Prerequisites: 48.350 and permission of instructor 3 cr

48.410 Seminar on Sex and Gender

This seminar explores a variety of questions related to sex and gender. This course considers different ways scholars have understood gender difference and gender inequality. Specific topics vary but may include the construction of gendered bodies, the social construction of sexuality, and so forth. 3 cr

48.421 Seminar on the Family

Study of the family structures and gender roles in various human societies. Prerequisites: 48.101 plus either 48.231 or 48.241 3 cr

48.450 Seminar on Peace, Violence & War

A research seminar on the social, cultural, political and economic aspects of war and peace. Special emphasis placed on ways to make and maintain peace in the world and particular regions. Prerequisite: permission of the instructor 3 cr

48.466 Seminar in Class, Status and Power

Emphasizes the impact of class, status, and power relationships on the social organization of past and present societies. Special attention is focused on processes for redistributing privileges and rewards in society. Prerequisites: 48.341 or 48.256 and permission of instructor 3 cr

48.469 Selected Topics

Concentrates on a different area of sociol-

ogy each time it is taught. See the Department Chairperson for more information 3 cr

48.481 Integrative Seminar in Developmental Disabilities II: Becoming involved in the life of a community.

This seminar offers students the opportunity for self-exploration, confronting diversity and community. Students will investigate how to make connections with the community that are real and valuable and how to enrich one's own or assist another person in enriching his/her life. Students will also look at how relationships are built and how to identify and where to find natural supports. (Field placement required) Restricted to Development Disabilities Program 3cr

48.484 Industry Internship

Open to all majors in Humanities and Social Sciences. Practical experience of work using liberal arts skills in private industry and/or using high technology. Prerequisite: permission of instructor 3 cr

48.485 Industry Internship II

A continuation of 48.484 3 cr

Directed Studies

Directed study courses are available only to majors in Sociology and may be taken provided that 1) the material to be covered is not available in any course offered during the semester in which a directed study course is contemplated, and 2) instructors are willing to undertake a directed study course.

48.491 Directed Studies in Sociology

The student, through regular and frequent consultation with an instructor, develops a course of directed reading in sociology and defines a problem for individual research. Prerequisite: permission of instructor. 3 cr

48.492 Directed Studies: Sociology

A one-credit, short course available only to qualified seniors. Prerequisite: Permission of Department Chairperson. 3 cr

48.495 Thesis in Sociology

A program of study which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to

initiate a new study. The purpose is to sharpen and refine techniques for scholarly research and presentation in the student's major discipline. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor. 3 cr

Practicum

48.496 Practicum Experience

A program of on-campus and/or off-campus experience for sociology majors and minors only. Specific requirements vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of six credits. Students are graded "satisfactory" and "unsatisfactory." The practicum experiences may not be substituted for a required course in the major. Prerequisite: permission of Chairperson. 3 cr

Interdisciplinary and Intercollegiate Programs and Minors

Interdisciplinary programs and minors offered by the University of Massachusetts Lowell include Classical Civilization, Cognitive Sciences, Comparative Arts, Cultural Studies, Film, Gender, German, Italian Languages, Latin American, Peace and Conflict, Technology, Society and Human Values, and Theater Arts. These programs provide students with opportunities to learn and apply modes of inquiry essential to multiple interrelated disciplines. Special emphases are placed on writing fluency, an essential skill for success not only in college work but throughout life; on diversity and the study of foreign cultures, so that students gain an appreciation of the uniqueness of each such culture as reflected in its language and history as well as the many traditions that make up our multicultural heritage; and on an understanding of the forces, figures and events that shape our country and our world.

Interrelating sciences, mathematics and analytical processes trains students to reason logically and think critically in both quantitative and qualitative modes. Moreover, direct experience in science for non-scientists, through experience both in lecture hall and in laboratory, is an essential part of the preparation of informed citizens, who will be called on increasingly in the future to understand the complex issues of science and technology relative to the risks and benefits of its applications.

Some programs involve philosophical inquiry and awareness regarding issues of fundamental human importance. Some grasp of the nature of humankind, of the criteria for knowledge and for making moral decisions fosters the essential lifetime skills of clear thinking, rational evaluation and critical self-reflection.

Interdisciplinary programs in the Social Sciences provide opportunities for inquiry into human behavior and its possibilities and limitations. Comparative studies in art history, literature, music history, and the humanities deepen understanding and appreciation of aesthetic, cultural, and

ethical values both of our own culture and of others.

Classical Civilization

Christos Bentas (History), Coordinator

Tel #: (978) 934-4272

Office: Coburn Hall, Room 108

Coursework for a minor area of study in Classical Civilization is selected in consultation with Dr. Christos Bentas of the History Department from the following disciplines: art, classics, English, history, Greek, Latin, philosophy, and western cultural heritage. Coursework for the classical civilization minor must be distributed in three areas with at least nine hours in one area, six hours in a second area, and three hours in a third area. Although courses in Latin or Greek are not required for the minor, students are urged to complete at least six hours of the minor in a classical language at the intermediate level. At least six hours must be taken in coursework at the 300 level or above.

Cognitive Science

Robert Kunzendorf (Psychology), Coordinator

Tel #: (978) 934-3967

Office: Mahoney Hall, Room 200A

A minor in Cognitive Science is designed primarily for the electrical engineering or computer science student who is interested in artificial intelligence. This interdisciplinary minor exposes the student to three methods of studying mental processes: philosophic and linguistic analysis, psychological experimentation, and computer simulation. Coursework in the minor in cognitive science is selected in consultation with Dr. Robert Kunzendorf of the Psychology Department.

The minor consists of 18-24 credits: at least six credits from each area and at least six credits at the 300 level or higher. Technical electives and approved electives may be used to fulfill the area C requirement. Core courses in area A or area B may be applied both to the university core requirement and to the cognitive science minor. Some prerequisites for the following courses in the cognitive science minor may be waived, with instructor consent.

A. Philosophic and Linguistic Analyses of Cognition

- 45.301 Ways of Knowing
- 45.305 Language, Signs, & Symbols
- 42.308 Analysis of Modern English
- 45.312 Philosophy of Science
- 45.330 Philosophy of Symbolic Logic
- 45.331 Philosophy of Mind
- 42.431 Contemporary Linguistic Theory

B. Psychological Experimentation on Cognition

- 47.276 Theories of Learning
- 47.277 Sensation and Perception
- 47.278 Cognitive Psychology
- 47.333 Psychology of Consciousness
- 47.373 Mind, Brain, and Behavior

C. Computer Simulations of Cognition

- 92.360 Introduction to Data Structures
- 92.459 Artificial Intelligence
- 92.465 Formal Languages
- 92.466 Theory of Computation

Comparative Arts

Liana Cheney (Art History), Coordinator

Tel #: (978) 934-3495

Office: Coburn Hall, Room 201

A Comparative Arts minor requires 18-24 credits in selected interdisciplinary courses. Six credits must be at the 300 level or above. A practicum in the arts community is strongly recommended. Comparative Arts may also be taken as a concentration in the Bachelor of Liberal Arts program. Courses relevant to the comparative arts minor are listed below. For course descriptions, see the department listing as indicated next to the course title.

- 42.211 Comparative Poetry (English)
- 52.380 Cinema: Themes and Directors (Modern Languages)
- 58.105 Comparative Arts (Art History)
- 58.305 Theater in the Visual Arts (Art History)
- 59.310 Arts and the Community (Intercollegiate)

59.340 Film as Art (Intercollegiate)

59.355 Critical Theories in the Arts (Intercollegiate)

59.494 Directed Studies in Comparative Arts

59.495 Advanced Tutorial in Comparative Arts

59.496 Practicum in Comparative Arts

74.252 Opera and Music Drama (Music)

74.356 American Musical Theater (Music)

Developmental Disabilities

Charlotte Mandell (Psychology), Coordinator

Tel #: (978) 934-3954

Office: Mahoney Hall, Room 110

A specialization in Developmental Disabilities is available through the Department of Psychology. Interested students should consult the chair of the Psychology Department.

59.482 Integrative Seminar in Developmental Disabilities III: Practicing Support.

Looking at strategies for building community supports offers students an opportunity to explore various intervention techniques, including the expressive therapies, behavior management, adult learning, counseling skills, crisis intervention and understanding family systems. (Field placement required) Restricted to Development Disabilities Program 3cr

59.483 Integrative Seminar in Developmental Disabilities IV: Advocating for change. This seminar will provide students with skills in system change, from the individual to the community levels. It will present basic human rights and investigate ways to support those rights. Students will explore self-advocacy, self-determination, person centeredness, handling discrimination and leadership within this context. (Field placement required.) Restricted to Development Disabilities Program. 3cr

Film Studies

Mario Aste (Languages), Coordinator

Tel #: (978) 934-4120

Office: Coburn Hall, Room 114

The interdisciplinary minor in Film Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the Italian language component. Additional courses to complete the required credits may be selected from the following list or other course listings in this catalogue.

- 42.230 Film Classics
- 42.234 The Documentary Film
- 42.241 Women in Film
- 50.376 French Cinema & Society
- 50.378 Women in French Cinema
- 50.374 Classics of Italian Cinema
- 52.378 Italian Cinema & Culture
- 52.380 Italian Cinema: Themes and Directors

At least six credits must be taken in coursework at the 300 level or above. The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the appropriate coordinator to see which courses are currently approved.

Gender Studies

Susan Gallagher (Political Science), Coordinator

Tel#: (978) 934-4253

Email: Susan_Gallagher@uml.edu

Office: Dugan Hall, Room 218

As indicated by the diversity of courses listed here, ideas about gender help to shape our understanding of psychology, philosophy, politics, economics, literature, history, business, criminal justice, sociology, art history, communications, and law. The Gender Studies Minor is designed to deepen students' insight into the formative role of gender in the theoretical definition, historical development, and practical aspects of all of these fields.

While all of our courses address gender-related issues, most focus on the way gen-

der inequality has influenced and still constricts women's lives. Without slighting men's experience, these courses enable students to explore how sex discrimination affects women of different races, cultures, classes, and sexual orientations. Since gender bias remains one of the defining aspects of contemporary society, this approach should appeal not only to women, but also to all students who hope to understand the major issues of our time.

Minor Requirements

The Gender Studies minor requires 18-24 credits in designated interdisciplinary courses. 6 credits must be taken at the 300 level or above. Gender studies may also be taken as a concentration in the Bachelor of Liberal Arts major.

Students may take courses within their major and designate them for the Gender Studies Minor provided that the total number of credits in their major does not exceed 45 of the 120-credit minimum required for graduation.

For a current schedule of Gender Studies courses, as well as information on various gender-related topics, please visit the Gender Studies Web Site:

http://www.uml.edu/misc/gender_studies/

Gender Study Courses

The following courses are approved for the Gender Studies Minor. Please see department listing for complete course descriptions.

Note: The prefix for Introduction to Gender Studies (##.240) varies according to the department in which it is taught.

Art History

- 58.340 Women and Art
- Criminal Justice
- 44.360 Gender, Race and Crime
- 44.477 Domestic Violence
- Economics
- 49.305 Women, Minorities & Immigration

English

- 42.241 Women in Film
- 42.243 Contemporary Women Writers
- 42.244 Women in the Middle Ages and Renaissance

- 42.257 The Family in Literature
- 42.335 American Women Novelists
- History
- 43.270 Women in American History
- 43.378 Seminar: Women and Work
- 43.379 Work and Society
- 43.385 History of Family and Childhood in the U.S.

Languages

- 50.378 Women in French Cinema
- 52.330 Italian Women Writers
- 54.330 Spanish/Latin American Women Writers

Management

- 66.450 Labor Diversity & HRM
- Political Science
- 46.220 Gender and Politics
- 46.225 Gender, Work, and Politics
- 46.302 Gender, Law, and Politics
- 46.304 Privacy in American Politics
- 46.320 Gender in Political Theory

Psychology

- 47.322 His Job/Her Marriage: Gender, Work & Family
- 47.335 Psychology and Women
- 47.351 Human Sexuality
- 47.523 Women in the Community (per mission of instructor required)

Regional Economic and Social Development

- 57.211 Production & Democracy
- 57.353 Managing Workplace Diversity
- 57.504 Gender Differences at Work

Sociology

- 48.110 Patriotism, Religion and Motherhood
- 48.231 Sociology of the Family
- 48.370 Women in Society
- 48.305 Sociology of Family Law
- 48.331 Seminar: Reproductive Technology
- 48.410 Seminar: Sex and Gender

Gender Studies Interdisciplinary Courses**59.240 Introduction to Women's Studies**

This course is an interdisciplinary introduction to the field of Women's Studies that examines both commonalities and differences among diverse groups of women. A variety of topics are presented such as past and present stratification in work and family, sexual identities, medial representations of women, and violence against women. Social movements for women's equality and feminist theories and methods are also introduced.

59.307 Gender Issues in 19th Century American Literature and Popular Culture

In the 19th century, Americans consciously sought to define themselves, calling for a recognizable literature that would illuminate and celebrate national character. Defining the roles, behaviors, and even the very nature of men and women in the republic became an important corollary to this endeavor. These definitions and values were promulgated not only through traditional arts and literature, but also through magazines, etiquette manuals, and advertisements. We will examine selected texts from high and popular culture to see how gender operates to define individual character and to illuminate social issues, public images, and national myths.

3 cr

59.308 Gender Issues in 20th Century American Literature and Popular Culture

In the 20th century, attitudes toward the gender roles defined by 19th century Americans underwent enormous changes which are reflected in all aspects of culture, both "high" and popular. As first movies then television came to dominate leisure time, the images mass media conveyed of stereotypical male and female behavior played a major role in defining perceptions of gender roles. This course will examine these changing perceptions and their implications in novels, film and television.

3 cr

59.310 Gender Violence in the United States

This course examines the gender implications and underlying assumptions about women and men that are implicit in our laws dealing with gender violence, theo-

ries of violence and crimes, and responses to this violence by our justice system. In the first part of the course, we will examine some of the theories of gender domination and inequality. In the second part of the course we will apply our theoretical insights to the specific applications of gender violence and oppression. We will consider both individual acts of violence such as rape, incest, sexual abuse, wife and child battering and gay bashing as well as harmful acts in institutional violence including sexual harassment, pornography and corporate violence.

3 cr

59.311 Men, Women, and the Military

War and military affairs have traditionally been considered "men's business." This course will examine both the expectations and the reality of this gender assignment. We will look at the roles both men and women have played in past wars and in the nation's military policies. We will consider why this has been, and ask how the situation is changing as women become a greater proportion of the USA's armed forces.

3 cr

59.312 Issues in Human Reproduction

Birth control and abortion enable couples to have sex without having babies; new reproductive technologies like in-vitro fertilization enable couples to have babies without having sex. Public policies as well as individual activities affect changes in sex, marriage, childbearing, and other issues in human reproduction. We will see how the roles of men and women are affected by these changes in motherhood and fatherhood.

3 cr

59.322 Gender, Work and Family

This course examines ways that gender is related to contemporary work roles, family roles, and social institutions. Why is it that men rise to the top in "women's professions," while women do not in male fields? Why are mothers treated differently from fathers in the workplace and why is housework not seen as work? Why do we idealize the "nuclear" family when most people live in other kinds of families? Exploring relationships among gender, paid work and diverse types of families will allow us to critique current social arrangements and to discuss options for healthier, more equitable alternatives for the future.

3 cr

German Studies

Mario Aste (Languages), Coordinator

Tel #: (978) 934-4120

Office: Coburn Hall, Room 114

The interdisciplinary minor in German Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the German language component. Additional courses to complete the required credits may be selected from the following list or other courses currently listed in this catalogue.

- 43.217 Renaissance and Reformation
- 43.222 Europe in the 20th Century
- 43.255 History of Germany to 1871
- 43.337 History of Germany Since 1871
- 58.323 Northern Renaissance Art
- 59.320 Northern Baroque Culture

At least six credits must be taken in coursework at the 300 level or above. Beginning courses in German at the 100 level may not be credited to the German Studies minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the Chairperson of the Language Department to see which courses are currently approved.

Italian Studies

Mario Aste (Languages), Coordinator

Tel #: (978) 934-4120

Office: Coburn Hall, Room 114

The interdisciplinary minor in Italian Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the Italian language component. Additional courses to complete the required credits may be selected from the following list or other course listings in this catalogue.

- 43.313 Renaissance and Reformation
- 52.315 Italian American Literature and Cinema
- 52.371 Dante's Divine Comedy
- 52.373 Italian Humanism

- 52.376 Pirandello: Theatre and Influence
- 52.378 Italian Culture and Cinema & Literature
- 58.321 Italian Renaissance Art
- 58.322 Baroque Art in Italy

At least six credits must be taken in coursework at the 300 level or above. Beginning Italian courses at the 100 level may not be credited to the Italian minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the Chairperson of the Language Department to see which courses are currently approved.

Latin American Studies

George Luter (History), Coordinator

Tel #: (978) 934-4276

Office: Coburn Hall, Room 107

Courses for a minor field in Latin American studies are selected in consultation with Professor George Luter of the history department from a list of approved courses in history, economics, languages, and literature. Six credits at the 200 level or above are required for the Spanish language component. Coursework for the Latin American Studies minor must meet the following distribution requirement:

Spanish Language	6 cr.
History/Economics	6 -9 cr.
Latin American Lit	6-9 cr.

At least six hours in non-language courses must be taken in course work at the 300 level or above.

Students majoring in Spanish or Modern Languages (with Spanish option) may elect the Latin American studies minor but may not offer any course in Spanish language or literature (prefix: 54) as part of the 18-24 semester credits.

Peace and Conflict Studies

John MacDougall (Sociology), Coordinator

Tel #: (978) 934-4303

Office: O'Leary Library, Room 500E

Social conflicts are probably inevitable in human societies, but it is preferable to devise constructive ways, short of large-scale violence, for resolving conflicts.

The goals of the Peace and Conflict Studies minor are:

- to communicate basic facts and insights regarding war and large-scale conflicts, especially in the contemporary world;
- to discuss efforts and proposals for peacemaking, together with their principal strengths and weaknesses; and
- to develop a critical yet respectful and informed awareness of the diversity of policies and values about war and peace.

Requirements for the Minor

Any undergraduate can minor in Peace and Conflict Studies (PCS). A minor must take:

- five to seven courses from the list available from the PCS coordinator, of which at least one must be at the 300 or 400 level. These courses are in English, History, Philosophy, Political Science, Sociology and Languages;

- Peacemaking Alternatives, 48.215

PCS minors can also choose from a list of PCS courses available at other schools in the NECCUM consortium, including the Peace Studies Minor at Salem State College. Where a PCS course meets the university core requirement in Values, it can also be used to meet that requirement; and

- Seminar on War & Peace, 48.450

Technology, Society and Human Values

The courses offered in this program are interdisciplinary in their content and structure and are designed to explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team-taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (scientific, philosophical, and historical) of the period studied and the interrelationship of technology and human values.

A minor in Technology, Society, and Human Values consists of 18 to 24 credits of coursework. At least six credits must be selected from courses which are numbered 300 and above. With approval, related courses, other than those specifically listed below, may be offered to satisfy the minor. For more information, contact the Dean of Humanities and Social Sciences.

Technology, Society and Human Values Courses

59.203 Technology and Human Values I

A team-taught course on interrelationship of technology and human values. It explores the industrial revolution in Lowell, followed by an examination of topics drawn from areas such as agriculture, third world development, population control, energy and natural resources, household technology, and transportation. Unifying themes are the values associated with science and technology, the role and responsibility of the scientist and technologist, and the question of whether scientific and technological development should be and can be controlled. 3 cr

59.204 Technology and Human Values II

A continuation of 59.203. 3 cr

59.214 Nuclear Weapons, Values and Society

Examines popular values and conceptions concerning nuclear weapons, and of the political, diplomatic and economic issues surrounding those weapons. Analyzes the strategic and political interests of the major powers, and alternatives to the nuclear arms race. 3 cr

59.303 Understanding Technological Risk

How safe is safe enough? Who really was Dr. Frankenstein? Was it possible not to create the A-bomb? What do Elvis and Adolph have in common? Learn how viewing the same phenomena from two different disciplines can enhance decision-making capabilities crucial to survival in a technological age. A nuclear engineer and a literary scholar together examine the many value issues involved in understanding the nature of technological risk and its impact on modern society. Focusing on questions of scientific responsibility and social safety, students examine changing

attitudes about technology and values, using novels, films, historical accounts, guest lecturers, panel discussions and debates. 3 cr

59.306 Evolutionary Thought

Considers the impact of Darwin's evolutionary theory on modern biological science, social thought, and literature. 3 cr

59.309 The Engineer in Society

Examines the role of the engineer in society from an interdisciplinary perspective. How has this role changed? What can be expected for the future? The engineering personality, ethics and engineering, and engineers in industry are covered. The format of the class encourages discussion of the issues. Each student prepares a substantial report on a topic of personal interest. 3 cr

59.321 Literature on Technology and Human Values

Examines nineteenth and twentieth century literature to understand the impact of modern technology on the development of ethical values. Possible readings include Atwood, *The Handmaid's Tale*; DeLillo, *The Names*; Dick, *Blade Runner*; Hoffman, *At Risk*; Huxley, *Brave New World*; and Shelley, *Frankenstein*. 3 cr

59.330 Political, Social, and Technological Alternatives

Examines alternatives to the organization and dominant values of Western technological society, explores work, political systems, family, and technological change. 3 cr

59.333 Technology and Gender

Analyzes gender perspectives of technology, focusing on invention, work, values, and new technologies. 3 cr

59.350 Seminar in Technology and Human Values

Intensive study of selected topics. 3 cr

59.388 Seminar in Industrial Lowell

An interdisciplinary course on the growth, decline and rebirth of Lowell, MA from its inception as the first planned industrial city to the present. This course complements the establishment of the first Urban National Park in Lowell. 3 cr

59.395 Computers in Society

Explores the history of computers and their interaction with contemporary socie-

ty. It begins by looking at the nature of computers and their development from Charles Babbage to the present and continues with a series of specific examples dealing with the possibilities and problems arising from the use of computers in different areas of contemporary life. Examines the use of computers in education, the military, and business. The final section deals with the issues of individual freedom and control. Encourages students from many disciplines to examine critically the place of this new machine in their lives. 3 cr

59.420 Project in Technology and Human Values

Student projects involving technology, society and human values. 3 cr

59.501 Advanced Seminar in Technology and Human Values

Intensive study on the graduate level of selected topics in technology, society and human values. 3 cr

58.490 Art, Science and Technology

Examines the interrelationship between the visual arts and technological/scientific developments in selected historical frameworks. Demonstrates the close correlation between the artist, society and science/technology. It suggests how technology responds to the requirements in artistic endeavors, and how the artist's awareness of, or need for, new technology stimulates revolutionary changes in painting, sculpture or architecture. 3 cr

Theatre Arts

Nancy Selleck (English), Coordinator

Tel #: (978) 934-4185

Office: O'Leary Library, Room 420

The interdisciplinary minor in Theatre Arts is designed to offer students professional instruction and supervision in the practical work of theatre together with critical study of the history and forms of dramatic literature. Courses in this program are drawn from various departments, including English, Music, Art, and Languages. The minor consists of 18-24 credits of coursework (6 credits of which must be at the 300 level or above) in the following four categories:

1. Theatre arts workshops: at least 6 credits.* Students are encouraged to take

59.384, *Working with the Playscript*, at the beginning of their coursework.

2. Dramatic literature and music: at least 6 credits.* At least 3 credits must be in pre-modern drama.

3. Practicum in theatre: 3 credits. To be arranged during pre-registration period.

4. Production experience and portfolio credit. (See the Program Coordinator for details.)

* A list of approved courses is available from the Program Coordinator.

Theatre Arts Courses

For descriptions of approved English, Music, Languages, and Art courses, see the appropriate departmental listings.

59.252 Stagecraft

An introduction to the basic elements of technical theatre through a combination of classroom and hands-on training. 3 cr

59.261 Acting I (also 42.261)

Theory and practice of acting including exercises in the elements and methods of acting and the preparation of a public performance. 3 cr

59.262 Acting II (also 42.262)

A continuation of 59.261. Prerequisite: 59.262 or the instructor's permission. 3 cr

59.264 Directing Workshop (also 42.264)

Introduction to the process and responsibilities of directing plays of different styles. Students will direct scenes with other members of the workshop and their work will be analyzed by the instructor and their fellow students. 3 cr

59.304 Playwriting I (also 42.304)

Theory and practice of playwriting. Conducted as a workshop with close analysis of student work. 3 cr

59.367 Playwriting II (also 42.367)

Advanced workshop in writing plays. Prerequisite: 59.304 or the instructor's permission. 3 cr

59.384 Working with the Playscript (also 42.384)

A hands-on introduction to the dramatic text as a script intended for production. Conducted as a seminar/workshop with attention to both the critical interpretation and staging of a variety of dramatic forms. 3 cr

59.386 Theatrical Design

An introduction to the various aspects of theatrical design: lighting, costuming, and set design. 3 cr

59.390 Classics in Performance

A studio performance class focusing on the work of the actor in performance of major plays from various historical periods. Class will culminate in either a showcase of scenes or a production of a selected text. 3 cr

59.404 Topics in Theatre

Advanced study of a selected area of theatrical production, history, texts, or theory, taking into consideration the strengths and interests of current students in the program and the instructor. 3 cr

59.459 Production Workshop

Production of a full-length play or showcase of scenes, leading to a public performance. 3 cr

59.495 Practicum in Theatre

A part-time full-semester internship at an approved off-campus theatre. To be arranged through the Program Coordinator during pre-registration period. 3 cr

Western Cultural Heritage

Liana Cheney (Art History), Coordinator

Tel #: (978) 934-3495

Office: Coburn Hall, Room 201

The interdisciplinary minor in Western Cultural Heritage requires 18-24 credits of coursework. At least six credits must be from courses which are numbered 300 or above.

The courses offered in this program are interdisciplinary in their content and structure and explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team-taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (artistic, literary, philosophical, and historical) of the period studied and focus on the aspirations and achievements of our own civilization.

Western Cultural Heritage Courses**59.205 Human Values in Western Culture I**

Addresses some of the important questions of human existence through a close study of representative literary, philosophical, and religious texts from ancient times to the present and relevant modern works in the behavioral and political sciences. In the first semester the students explore and evaluate three perennial themes: the problem of evil, self and society, freedom and fate. In the second semester course, the thematic units are: the pursuit of knowledge, the nature of humankind, and the experience of love. 3 cr

59.206 Human Values in Western Culture II

A continuation of 59.205. May be taken independently of 59.205 3 cr

59.208 Western Cultural Heritage I

The actual development of a culture proceeds on many levels at once; the art, literature, philosophy and social structure of a given historical period evolve together, interact with one another, and eventually give rise to a new era. These courses are designed to capture the richness of the various periods of western civilization, to discern networks of dependency and influence among the diverse aspects of epoch's culture and to trace lines of continuity between one age and another. The first semester will treat the period from ancient civilization to the Protestant reformation; the second semester will focus on developments from the seventeenth through the twentieth centuries. 3 cr

59.209 Western Cultural Heritage II

A continuation of 59.208. May be taken independently of 59.208, Western Cultural Heritage I. 3 cr

59.248 Values in American Culture

Examines the relationship among American views on humanity, nature and democracy and shows how these relationships affect attitudes towards the individual, the "American Dream," science and technology. Readings are selected from authors as diverse as the Puritans, the ex slave Douglass, Wharton, Hemingway and Oppenheimer and include such genres as the essay, the short story, autobiography and the magazine article. Topics to be considered include immigration, technological invention, and the modern application of

democratic principles to the business community. The course shows how an evolving system of values in America is a factor influencing both individual and national decisions. 3 cr

59.313 The Culture of Ancient Greece

No one term can capture completely the richness of Greek culture, but there is one which comes closer than any other: TO KALON, which means nobility, goodness, or beauty. Taking this term as a guideline, we explore the many facets of Greek culture by focusing upon social and political structures, the development of moral consciousness, and the appreciation of beauty. These issues are approached through the examination of developments in Greek art as well as through reflection upon works by Greek poets, dramatists, philosophers and historians. 3 cr

59.314 Society and Culture in the Early Middle Ages

Explores the political, social and cultural transformation which took place in Europe during the five centuries following the collapse of the western Roman Empire. Drawing from historical, literary, linguistic and artistic sources. The classes and lectures focus on the classical, Christian, Germanic and Celtic contributions to the new society and culture that was being created in Europe at this time. A major aim of the course is to make the students aware of how this formative period of the early Middle Ages can help us understand the full achievements of medieval society and culture at its zenith and, ultimately, the European civilization to which it gave birth. 3 cr

59.315 Islamic Culture and Medieval Europe

Helps the student to understand the major tenets of Islamic culture and to analyze its growth and dissemination in the Mediterranean basin. Examines the relationship of Islamic culture to medieval Europe via Moorish civilizations of Spain and, to a lesser extent, of Sicily. 3 cr

59.320 16th Century Italian Culture

Examines the literary, artistic and musical works of the Italian Renaissance in the sixteenth century, focusing on the theories governing the creation of these works, their backgrounds in classicism, their inter-relationship as a part of the humanistic movement, changes in modes of repre-

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sentation and the emergence of new genres. Examines the socio-historical conditions leading to the ideal of "universality," to the role of the Italian courts and academies in fostering the arts, and to the historical development of the Reformation and counter-Reformation. 3 cr

59.330 17th Century European Culture

Examines views of the individual and the emergence of the modern state. Concentrating primarily on France, England and the Netherlands, we examine the political and social organizations of these emergent nations, and the various views of human nature which are expressed in their literature, philosophy and art. A principal goal is to discern how the art-forms and ideas of individuals influence and are influenced by the social and political structures around them. 3 cr

Faculty

Deans

Nancy Kleniewski, A.B., M.A., Ph.D., Dean of Fine Arts, Humanities, and Social Sciences

Robert H. Tamarin, B.S., Ph.D., Dean of Sciences

Chairpersons

Robert Lynch, A.B., M.S., D.Sc., Biological Sciences

Edwin Jahngen, B.S., Ph.D., Chemistry

James Coates, B.F.A., M.F.A., Art

Thomas M. Costello, B.S., M.A., Ph.D., Computer Science

Eva Buzawa, A.B., M.S., Ph.D., Criminal Justice

Arnold L. O'Brien, A.B., M.S., Ph.D., Environmental, Earth, and Atmospheric Sciences

William Roberts, B.A., B.Sc., M.A., Ph.D., English

Ernesto Sanz, B.A., M.A., M.A., Ph.D., Economics

Charles F. Carroll, A.B., A.M., Ph.D., History

Mario Aste, A.B., A.M., Ph.D., Languages

Vidhu Prasad, B.S., M.S., Ph.D., Mathematical Sciences

Robert Innis, A.B., S.T.B., A.M., Ph.D., Philosophy

James Egan, B.A., M.S., Ph.D., Physics and Applied Physics

William A. Lindeke, A.B., M.A., Ph.D., Political Science

Charlotte Mandell, B.A., M.A., Ph.D., Psychology

William Moylan, B.M., M.M., D.A., Music

John Wooding, B.Sc., M.A., Ph.D., Regional Economic and Social Development

Carol Brown, B.S., M.S., Ph.D., Sociology

Professors Emeriti

Ruth Ashley, Associate Professor Emerita of Music; B.S.Ed., Lowell State College; M.Ed., Fitchburg State College

Adolph Baker, Professor Emeritus of Physics; B.A., M.S., City College of New York; B.M.E., Polytechnic Institute of Brooklyn; M.S., New York University; Ph.D., Brandeis University

William W. Bannister, Professor Emeritus of Chemistry; B.S., Ph.D., Purdue University

Leon E. Beghian, Professor Emeritus of Physics; B.A., Ph.D., Oxford University

Donald R. Berry, Associate Professor Emeritus of English; A.B., M.A., Baylor University

Alexandre Blumstein, Professor Emeritus of Chemistry; B.S. Sorbonne, Engineer, Institute de Chimie de Toulouse; Ph.D., University of Strasbourg

Rita Blumstein, Professor Emerita of Chemistry; B.S., Sorbonne; M.S., University of Strasbourg; Ph.D., University of Delaware

Dean Bouzianis, Professor Emeritus of Music; B.M., M.A., Boston University; M.M., National Conservatory of Greece; D.M.A., Boston University

Donald Bravo, Professor Emeritus of Music; B.M., New England Conservatory; M.M. Boston Conservatory

William C. Burto, Professor Emeritus of English; A.B., Colgate University; A.M., Ph.D., Harvard University

George L. Carr, Professor Emeritus of Physics; B.S., M.Ed., W. Maryland College; Ph.D., Cornell University

Robert M. Coleman, Professor Emeritus of Biological Sciences; B.S., Bates College; M.S., University of New Hampshire; Ph.D., University of Notre Dame

Robert C. Curtis, Professor Emeritus of Environmental, Earth, and Atmospheric Sciences; A.B., Williams College; Ph.D., Pennsylvania State University

Joyce Denning, Associate Professor Emerita of Political Science; A.B., Tufts University; A.M., Duke University

Richard L. Derry, Associate Professor Emeritus of History; A.B., Holy Cross College; A.M., Boston College

M. Brendan Fleming, Professor Emeritus of Mathematical Sciences; B.S., M.S., Boston College

Robert J. Foy, Professor Emeritus of English; B.S., Plymouth State College of U.N.H.; M.A., Ed.S., George Peabody College; Ed.M., Ed.D., Harvard University

Arthur Friedman, Professor Emeritus of English; A.B., City College of New York, A.M., Boston University

Robert Griffith, Associate Professor Emeritus of Art; B.S. Ed., Massachusetts College of Art; M.F.A., Pratt Institute

F. Raymond Hardy, Professor Emeritus of Physics; B.S., M.S., Lowell Technological Institute

Jesse Y. Harris, Professor Emeritus of Physics (Radiological Sciences); B.S., M.S., Ph.D., Rutgers University

Antone Holevas, Associate Professor Emeritus of Music; B.M. Butler University; M.M., Boston University

Stanley C. Israel, Professor Emeritus of Chemistry; B.S., Parsons College; Ph.D., Lowell Technological Institute

Ernest P. James, Professor Emeritus of Chemistry; B.T.C., M.S., Lowell Textile Institute

Ethel N. Kamien, Professor Emerita of Biological Sciences; B.A., Brooklyn College; M.S., Ph.D., University of Wisconsin

Gerald Kaiser, Professor Emeritus of Mathematical Sciences; B.S., Case Institute of Technology; M.S., Ph.D., University of Wisconsin; Ph.D., University of Toronto

Shirley Kolack, Professor Emerita of Sociology; B.S., A.M., Ph.D., Boston University

Thomas G. Kudzma, Associate Professor Emeritus of Mathematical Sciences; B.S., Massachusetts Institute of Technology; A.M., Harvard University

Anthony Liuzzi, Professor Emeritus of Physics; B.S., Rensselaer Polytechnic Institute; M.S., Ph.D., New York University

John F. Lyon, Professor Emeritus of Biological Sciences; B.S., M.S., University of New Hampshire

Thomas V. Marcella, Professor Emeritus of

Physics; B.S., Lowell Technological Institute; M.S., Northeastern University; Ph.D., Boston College

Suresh Mathur, Professor Emeritus of Physics; B.S., M.S., University of Lucknow, India; Ph.D., University of Texas

Walter R. Mellen, Professor Emeritus of Physics; S.B., Massachusetts Institute of Technology; M.S., Lowell Technological Institute

Arthur I. Miller, Professor Emeritus of Philosophy; B.S., City College of New York; Ph.D., Massachusetts Institute of Technology

Gerard W. O'Connor, Professor Emeritus of English; A.B., Harvard University; A.M., Ph.D., Boston University

Natalo Paella, Professor Emeritus of Music; B.M., Louisiana State University; M.M., New England Conservatory

Gerard A. Paquette, Professor Emeritus of Mathematical Sciences, B.A., LaMennais College; M.A., Boston College; Ph.D., The Pennsylvania State University

Judith Pastore, Professor Emerita of English; A.B., Rutgers University; A.M., Radcliffe College; Ph.D., Harvard University

James B. Pierce, Professor Emeritus of Chemistry; B.S. Theil College; M.S., Ph.D., Case Institute Technology

Carlton Plummer, Professor Emeritus of Art

Nicholas J. Rencricca, Professor Emeritus of Biological Sciences; B.S., St. Francis College; M.S., St. Johns University; Ph.D., Boston College

Paul J. Ring, Professor Emeritus of Physics (Radiological Sciences); B.S., Boston College; M.S., Rensselaer Polytechnic Institute; Ph.D., Brown University

Harry Rubinstein, Professor Emeritus of Chemistry; B.S., Brooklyn College; Ph.D., Purdue University

Joseph C. Salamone, Professor Emeritus of Chemistry; B.S., Hofstra University; Ph.D., Polytechnic Institute of Brooklyn

Bernard Shapiro, Professor Emeritus of Mathematical Sciences; B.S., Lowell Technological Institute; S.M., Massachusetts Institute of Technology

Eric Sheldon, Professor Emeritus of Physics; B.Sc., B. Sc., Ph.D., D.Sc., University of London

Prentiss Shepherd, Jr., Professor Emeritus of Biological Sciences; A.B., A.M., Harvard University

Kenneth W. Skrabble, Professor Emeritus of Physics (Radiological Sciences); B.S., Moravian College; M.S., Vanderbilt University; Ph.D., Rutgers University

Malcolm K. Smith, Professor Emeritus of Physics; B.S., Haverford College; M.A. Columbia University

Rawn Spearman, Professor Emeritus of Music; B.S., Florida A&M University; M.A., Ed.D., Columbia University

Wen Tang, Professor Emeritus of Environmental, Earth, and Atmospheric Sciences; B.S., Nat'l Central University (China); M.S., Ph.D., New York University

Virginia S. Taylor, Professor Emerita of Mathematical Sciences; B.S., Syracuse University; M.A., Western Michigan University; Ph.D., Boston College

Willis Traphagan, Professor Emeritus of Music; B.A., Ithaca College; M.M., Boston University

Robert White, Professor Emeritus of Music; M.M., New England Conservatory; M.A., Harvard University; D.M.A., Boston University

Roger Wiehe, Professor Emeritus of English; B.A., Yale University; M.A., University of Illinois; Ph.D., Columbia University

Joyce W. Williams, Associate Professor Emerita of Mathematical Sciences; B.A., University of Minnesota; M.S., Ph.D., University of Illinois

Francis Worrell, Professor Emeritus of Physics; B.S., University of Michigan; M.S., Ph.D., University of Pittsburgh

Charles E. Zivarras, Professor Emeritus of English; B.S., M.A., Boston University

Faculty

Eunice Alberts, Adjunct Faculty of Music; B.M., New England Conservatory

Albert Altman, Professor of Physics; B.S., Brooklyn College; M.S., Ph.D., University of Maryland

Anastasios Angelopoulos, Assistant Professor of Chemistry; B.S., M.S., Tufts University; Ph.D., Princeton University

Diana Archibald, Assistant Professor of English; B.A., Pacific Lutheran University; M.A., California State University, Sacramento; Ph.D., Washington State University

Doreen Arcus, Assistant Professor of Psychology; B.A., St. Xavier College; M.A., Harvard University; M.A., Western Michigan University; Ph.D., Harvard University

Mario Aste, Professor of Languages; A.B., University of Turin; A.M., Ph.D., Catholic University

Eugene F. Barry, Professor of Chemistry; B.S., Villanova University; Ph.D., University of Rhode Island

Caryn Cosse Bell, Assistant Professor of History; B.A., M.A., University of New Orleans; Ph.D., Tulane University

Janice Bennett, Adjunct Faculty of Music; B.M., Boston University; Christos J. Bentas, Professor of History; A.B., Ed.M., Boston University; A.M., Ph.D., Tufts University

Dean J. Bergeron, Professor of Regional Economic and Social Development; A.B., St. Michael's College; A.M., Villanova University

Shimshon Berkovits, Professor of Mathematical Sciences; S.B., Massachusetts Institute of Technology; M.S., University of Chicago; Ph.D., Northeastern University

William R. Berkowitz, Associate Professor of Psychology; A.B., Cornell University; Ph.D., Stanford University

Anne Black, Adjunct Faculty of Music; B.A., University of California; M.M., Yale

Mary Blewett, Professor of History; A.B., A.M., Ph.D., University of Missouri

Peter Blewett, Professor of History; A.B., Northeastern University; A.M., Ph.D., Boston College

Meg Bond, Professor of Psychology; B.A., Stanford University; M.A., Ph.D., University of Oregon

Susan J. Braunhut, Professor of Biological Sciences; B.A., Kent State University; M.A., University of Hartford; M.A., M.Phil., Ph.D., Columbia University

Ronald I. Brent, Professor of Mathematical Sciences; B.S. State University of New York at Binghamton; M.S., Ph.D., Rensselaer Polytechnic Institute

Carol Brown, Associate Professor of Sociology; A.B., M.A., Bucknell University; Ph.D., Columbia University

Fred Buda, Adjunct Faculty of Music; B.M., Boston University

John Buford, Associate Professor of Computer Science; B.S., M.S., Massachusetts Institute of Technology; Ph.D., Technical University of Graz

Janet Burke, Professor of Psychology; B.S., M.Ed., Ph.D., Boston College

William J. Burke, Professor of Legal Studies; B.A., University of Massachusetts; M.Ed., Boston State College; J.D., Suffolk University

Eva Buzawa, Professor of Criminal Justice; A.B., University of Rochester; M.S., Ph.D., Michigan State University

Charles L. Byrne, Professor of Mathematical Sciences; B.A., Georgetown University; M.A., Ph.D., University of Pittsburgh

James M. Byrne, Professor of Criminal Justice; A.B., University of Massachusetts; M.A., Ph.D., Rutgers University

James Canning, Associate Professor of Computer Science; A.B. University of Maine; M.S., Iowa State University; Ph.D., Virginia Polytechnic Institute

Joan Cannon, Associate Professor of Psychology; A.B., St. Mary's College; M.Ed., Boston University; Ed.D., Clark University

Mark Cantrell, Adjunct Faculty of Music; B.M., Boston University

Sandra Carlson-Wood, Adjunct Faculty of Music; B.S., University of New Hampshire, M.M., University of Massachusetts Lowell

Charles F. Carroll, Professor of History; A.B., A.M., Boston College; Ph.D., Brown University

Michael J. Carter, Associate Professor of Economics; B.A., Yale University; M.A., Ph.D., Stanford University

Alexander Case, Adjunct Faculty of Music; B.S., Rice University; B.M. Berklee College of Music

Jacqueline Charette, Associate Professor of Music; M.M., Rivier College; Ed.D., Boston University

George E. Chabot, Jr., Professor of Physics; A.B., Harvard University; M.S., Harvard School of Public Health; Ph.D., University of Lowell

Shehong Chen, Assistant Professor of History; B.A., Shanghai Foreign Languages Institute; M.A., Ph.D., University of Utah

Liana De Girolami Cheney, Professor of Art History; B.S., A.M., University of Miami; Ph.D., Boston University

Levon Chorbajian, Professor of Sociology; A.B., Temple University; A.M., University of Michigan; Ph.D., Brandeis University

Partha Chowdhury, Associate Professor of Physics; B.Sc., Indian Institute of Technology; M.S., Ph.D., State University of New York, Stonybrook

Lisa Cleveland, Adjunct Faculty of Music; B.M., University of Missouri KC; M.M., Ph.D., Northwestern University

James Coates, Professor of Art; B.F.A., University of South Carolina; M.F.A., Clemson University

Frank P. Colby, Jr., Professor of Environmental, Earth, and Atmospheric Sciences; B.S., University of Michigan; M.S., Ph.D., Massachusetts Institute of Technology

Andrea Corbett, Associate Professor of English; A.B., University of New Hampshire; M.A., Vanderbilt University

Ronald P. Corbett, Jr., Adjunct Faculty of Criminal Justice; A.B., Harvard University; M.S., Northeastern University

Thomas M. Costello, Professor of Computer Science; B.S., Boston College; M.A., Ph.D., University of Maryland

Gus P. Couchell, Professor of Physics; B.S., M.S., N. Carolina State University; Ph.D., Columbia University

William Coughlin, Associate Professor of English; B.S., Lowell State College; A.M., Middlebury College; Ed.D., University of Massachusetts

Arthur T. Dabilis, Assistant Professor of English; A.B., Suffolk University; M.A., Northeastern University

Mitra Das, Professor of Sociology; A.B., A.M., University of Rajasthan; Ph.D., University of Massachusetts

Nancy DeLuca, Associate Professor of Chemistry; B.S., Queen's College of New York; M.S., Ph.D., Ohio State University

George C. Dery, Associate Professor of Economics; A.B., Merrimack College; M.A., Boston College

Alan W. Doerr, Professor of Mathematical Sciences; B.A., Marist College; M.A., Hunter College

David T. Eberiel, Professor of Biological Sciences; B.S., Bethany College; M.S., Tufts University; Ph.D., Boston College

G. Nelson Eby, Professor of Environmental, Earth, and Atmospheric Sciences; A.B., M.S., Lehigh University; Ph.D., Boston University

Daniel Egan, Assistant Professor of Sociology; B.A., Hamilton College; M.A., Ph.D., Boston College

James J. Egan, Professor of Physics; B.A., Thomas More College; M.S., Ph.D., University of Kentucky

Tara Elyssa, Assistant Professor of English; B.A., Hope College;

M.A.Ed., Ed.D., Ball State University

Alma O. Espinosa, Professor of Music; B.M., Eastman School of Music; M.M., Pius XII Institute-Florence, Italy; M.A., Ph.D., New York University

Kristin G. Esterberg, Assistant Professor of Sociology; B.A., Boston University; M.A., Ph.D., Cornell University

Frederic Faudie, Professor of Art; A.B., Cornell University; M.A., University of Iowa; M.F.A., Syracuse University

Rudolf Faust, Professor of Chemistry; B.S., Ph.D., Eotvos Lorand University of Sciences (Budapest)

Jeffrey Fischer, Adjunct Faculty of Music; B.A., New England Conservatory

Joseph Foley, Adjunct Faculty of Music; B.M., M.M., Boston University

Robert Forrant, Associate Professor of Regional Economic and Social Development; M.A., Northeastern University; Ph.D., University of Massachusetts Amherst

John Craig Freeman, Assistant Professor of Art; B.A., University of California San Diego; M.F.A., University of Colorado

Jane Freimiller, Assistant Professor of Philosophy; B.A., Haverford College; M.A., Ph.D., Boston College

Clayton S. French, Jr., Professor of Physics; B.S., Lowell Technological Institute; M.S., Ph.D., University of Lowell

Zoltan Fried, Professor of Physics; B.S., Brooklyn College; Ph.D., Brandeis University

Monica Galizzi, Assistant Professor of Economics; Laurea, Università Cattolica, Milan; M.A., Boston University; Dottorato, Università Cattolica, Milan; Ph.D., Boston University

Susan E. Gallagher, Assistant Professor of Political Science; B.A., Ramapo College of New Jersey; M.A., Ph.D., New School for Social Research

Robert R. Gamache, Professor of Environmental, Earth and Atmospheric Sciences; B.S., Southeastern Massachusetts University; M.S., Ph.D., University of Massachusetts Amherst

Joseph Garreau, Professor of Modern Languages; A.B., University of Poitiers; S.T.L., Collège Saint Albert de Louvain, A.M., Ph.D., Boston College

Jeffrey Gerson, Assistant Professor of Political Science; B.S., State University of New York College at Brockport; Ph.D., City University of New York

Janice Giampa, Adjunct Faculty of Music; B.M., University of Connecticut; M.M., Yale

Dan S. Golomb, Associate Professor of Environmental, Earth, and Atmospheric Sciences; M.Sc., Hebrew University, Ph.D., Weizmann Institute of Science

Enrique Gonzalez-Velasco, Professor of Mathematical Sciences; B.S., Ph.D., Polytechnic University of Madrid; Sc.M., Ph.D., Brown University

William D. Goodhue, Professor of Physics; B.S. Worcester Polytechnic Institute; M.A., University of Massachusetts Amherst; Ph.D., University of Massachusetts Lowell

Richard Z. Gore, Associate Professor of Environmental, Earth, and Atmospheric Sciences; B.S., City College of New York;

M.S., Boston College; Ph.D., Boston University

Gary Gottlieb, Adjunct Faculty of Music; B.A., Temple University; M.A., Marlborough College

James Graham-Eagle, Associate Professor of Mathematical Sciences; B.S., M.S., Victoria University; Ph.D., Oxford University

Richard Greenblatt, Adjunct Faculty of Music; M.M., University of Lowell

Georges G. Grinstein, Professor of Computer Science; B.S., City College of New York; M.S., New York University; Ph.D., University of Rochester

Laurence F. Gross, Associate Professor of Regional Economic and Social Development; B.A., Wesleyan University; Ph.D., Brown University

Raymond D. Gumb, Professor of Computer Science; B.S., Massachusetts Institute of Technology; M.A., Emory University; Ph.D., Lehigh University

Garth Hall, Assistant Professor of Biological Sciences; B.S., McGill University, Ph.D., Yale University

Padmanabh Harihar, Professor of Physics; B.S., R. Ruia College (India); M.S., Wilson College (India); Ph.D., Columbia University

Jesse M. Heines, Associate Professor of Computer Science; B.S., Massachusetts Institute of Technology; M.S., University of Maine; Ed.D., Boston University

Jon C. Hellstedt, Professor of Psychology; A.B., Augustana College; B.D., Yale University; Ph.D., Boston University

Mark Henry, Adjunct Faculty of Music; B.A., Berklee College of Music, M.M., University of Massachusetts Lowell

J. Heli Hernandez, Professor of Spanish; A.B., University of Javeriana (Bogota); A.M., Ph.D., Catholic University

William R. Hersey, Professor of English; B.S., Lowell State College; M.A., Boston College; Ph.D., University of New Hampshire

David Hirschel, Professor of Criminal Justice; B.A., Cambridge University, England; M.A., Ph.D., State University of New York at Albany

Tad Hitchcock, Adjunct Faculty of Music

Jerome L. Hojnacki, Professor of Biological Sciences; Dean of the Graduate School, B.S., Southern Connecticut State College; M.S., University of Bridgeport; Ph.D., University of New Hampshire; M.H.A., Clark University

Hilary Holladay, Assistant Professor of English; B.A., University of Virginia; M.A., College of William and Mary; Ph.D., University of North Carolina at Chapel Hill

Gerald T. Hotaling, Professor of Criminal Justice; B.A., University of Delaware; M.A., Ph.D., University of New Hampshire

Kathleen D. Hulbert, Professor of Psychology; A.B., Northwestern University; Ed.M., Ed.D., Boston University; C.A.G.S., University of New Hampshire

Donald Hummer, Assistant Professor of Criminal Justice; B.S., Elizabethtown College; M.S., Shippensburg University; Ph.D., Michigan State University

Ann Marie Hurley, Associate Professor of Mathematical Sciences; A.B., Emmanuel College; M.S., University of Lowell

Robert Innis, Professor of Philosophy; A.B., St. Mary's College; S.T.B., Gregorian University; A.M., Ph.D., Fordham University

Martin Isaks, Associate Professor of Chemistry; B.S., Purdue University; M.S., Iowa State University; Ph.D., University of Cincinnati

Edwin D. Jahngen, Jr., Professor of Chemistry; B.S., Bates College; Ph.D., University of Vermont

Keith Jones, Adjunct Faculty of Music; B.A., Hartwick College; M.A., San Francisco State University; M.A., Ph.D., Stanford University

Lee K. Jones, Professor of Mathematical Sciences; B.S., Tufts University; M.S., Ph.D., Stanford University

Michael Jones, Associate Professor of Legal Studies, B.A., Denison University; M.B.A., University of Pennsylvania; J.D., University of Miami

Jeannie Sargent Judge, Assistant Professor of English, B.A., Lowell State College; M.A., Ph.D., Boston University

Lloyd C. Kannenberg, Professor of Physics; S.B., Massachusetts Institute of Technology; M.S., University of Florida; Ph.D., Northeastern University

Alan Kaplan, Associate Professor of Mathematical Sciences; B.S., University of Massachusetts; M.S., Ph.D., Syracuse University

Aram S. Karakashian, Professor of Physics; B.A., M.A., Temple University; Ph.D., University of Maryland

Russell R. Karl, Associate Professor of Legal Studies, B.S., Bryant College; M.S., Suffolk University; J.D., Suffolk Law School

Renée Kasinsky, Professor of Criminal Justice; A.B., M.A., Ph.D., University of California at Berkeley

Gunter H. R. Kegel, Professor of Physics; B.Ph., University of Brazil; Ph.D., Massachusetts Institute of Technology

Judith A. Kelley, Professor of Chemistry; B.A., Emmanuel College; M.S., Lowell Technological Institute; M.Ed., Ed.D., Northeastern University

Byung G. Kim, Associate Professor of Computer Science; B.S., Seoul National University; M.S., University of Massachusetts; Ph.D., University of Massachusetts

Nancy Kleniewski, Professor of Sociology; Dean of Fine Arts, Humanities and Social Sciences; A.B., Emmanuel College; M.A., Ph.D., Temple University

Albert D. Kowalak, Professor of Chemistry; B.S., College of William and Mary; M.S., Ph.D., Virginia Polytechnic Institute

Mary D. Kramer, Professor of English; A.B., University of Wisconsin; A.M., Ph.D., University of Kansas

Patrick D. Krolak, Professor of Computer Science; B.S., University of Chicago; M.A., D.Sc., Washington University

Sarah Kuhn, Associate Professor of Regional Economic and Social Development; B.A., Harvard College; Ph.D., Massachusetts Institute of Technology

Jayant Kumar, Professor of Physics; B.S., M.S., Indian Institute of Technology; Ph.D., Rutgers University

Robert Kunzendorf, Professor of Psychology; A.B., Yale University; M.A., Ph.D., University of Virginia

Supriya Lahiri, Professor of Economics; B.A., Presidency College (India); M.A., Ph.D., University of Delhi

Philip S. Lamprey, Professor of Chemistry; B.S., Lowell Technological Institute; Ph.D., University of New Hampshire

David Landrigan, Associate Professor of Psychology; B.S., Tufts University; M.A., Ph.D., University of New Hampshire

David Larsen, Professor of Physics; S.B., Ph.D., Massachusetts Institute of Technology

James Lattini, Adjunct Faculty of Music; B.M., University of Lowell; M.M. Boston University

William H. Lazonick, Professor of Regional Economic and Social

Development; B.Com., University of Toronto; M.Sc., London School of Economics; Ph.D., Harvard University

Robert J. Lechner, Professor of Computer Science; B.S., M.S., Carnegie-Mellon University; Ph.D., Harvard University

Siu-Lam Lee, Associate Professor of Biological Sciences; B.S., Chung Chi College (Hong Kong); M.A., Oberlin College; Ph.D., Cornell University

Paul Lehrman, Adjunct Faculty of Music; B.F.A., SUNY/Purchase

Kenneth M. Levasseur, Professor of Mathematical Sciences; B.A., St. Anselm College; M.S., Ph.D., University of Rhode Island

Haim Levkowitz, Associate Professor of Computer Science; B.A. University of Haifa; M.S.E., Ph.D., University of Pennsylvania

Clifford L. Lewis, Professor of American Studies and English; A.B., Union College; A.M., State University of New York at Buffalo; Ph.D., University of Texas

Frederick P. Lewis, Professor of Political Science; A.B., Columbia University; J.D., Harvard University; Ph.D., Tufts University

Kuang-Pang Li, Associate Professor of Chemistry; B.S., M.S., Taiwan National University; M.S., Ph.D., University of Illinois

Jonathan J. Liebowitz, Professor of History; A.B., Columbia University; M.A., Ph.D., University of California at Berkeley

Alan Lincoln, Professor of Criminal Justice; B.S., Michigan State; M.S., M.A., Ph.D., University of Massachusetts

William A. Lindeke, Professor of Political Science; A.B., M.A., San Diego State College; Ph.D., Claremont Graduate School

Joseph W. Lipchitz, Professor of History; A.B., M.A., University of Massachusetts; Ph.D., Case Western Reserve University

Irving Lipschitz, Associate Professor of Chemistry; B.A., M.S., New York University; Ph.D., Virginia Polytechnic Institute

Gerald J. Lloyd, Professor of Music; B.M., M.M., College-Conservatory of Music, University of Cincinnati; Ph.D., Eastman School of Music

George W. Luter, Associate Professor of History; B.S., A.M., Xavier University

Daniel Lutz, Staff Assistant and Adjunct Faculty of Music; B.M., Berklee College of Music

Robert D. Lynch, Professor of Biological Sciences; A.B., Northeastern University; M.S., D.Sc., Harvard University

John D. MacDougall, Professor of Regional Economic and Social Development; B.A., M.A., Oxford University; Ph.D., Harvard University

William MacMullen, Adjunct Faculty of Music; B.S., University of Western Connecticut

Inge Magid, Adjunct Faculty of Music; B.A., M.A., Drogobych State Music College; M.A., Webster University

Yuly Makovoz, Professor of Mathematical Sciences; M.S. University of Tchernovtsy; Ph.D., Urals University

John C. Mallett, Professor of Biological Sciences; B.S., College of the Holy Cross; M.S., Ph.D., University of Rhode Island

Charlotte Mandell, Professor of Psychology; A.B., Brooklyn College; M.A., Ph.D., Columbia University

David Martins, Professor of Music; B.M., Eastman School of Music; M.M., University of Lowell

Kenneth A. Marx, Professor of Chemistry; B.S., California State University at San Diego; Ph.D., University of California at Berkeley

William Mass, Associate Professor of Regional Economic and Social Development; B.G.S., University of Michigan; Ph.D., Boston College; M.P.H. Harvard University

Donald J. Mattheisen, Professor of History; A.B., A.M., Ph.D., University of Minnesota

Noëlle McAfee, Assistant Professor of Philosophy; B.A., University of Texas at Austin; M.A., Duke University, Institute of Policy Sciences and Public Affairs; M.A., University of Wisconsin; Ph.D., University of Texas at Austin

Allyssa McCabe, Associate Professor of Psychology; A.B., Oberlin College; M.A., Ph.D., University of Virginia

John M. McCaffrey, Associate Professor of English; A.B., Suffolk University; A.M., Tufts University

Arlene McCormack, Professor of Regional Economic and Social Development; A.B., M.A., Ph.D., Boston University

Peter McCoy, Assistant Professor of Music; B.M., Iowa State University; M.M., Ph.D., Northwestern University School of Music

Melisenda McDonald, Professor of Chemistry; A.B., Dowling College; M.A., Ph.D., State University of New York at Buffalo

Carol C. McDonough, Professor of Economics; B.A., Marymount Manhattan College; M.A., Ph.D., Boston College

Christopher McGahan, Professor of Music; B.A., University of Massachusetts at Amherst; M.M., University of Wisconsin-Madison; D.M.A., University of Illinois-Urbana/Champaign

Martha McGowan, Professor of English; A.B., Brandeis University; A.M., Boston College; Ph.D., Boston University

Roger D. McLeod, Associate Professor of Physics; B.A., Bowdoin College; M.S., Lowell Technological Institute

Anthony Mele, Professor of Music; B.M., Ithaca College; M.M., Boston University

Eugene Mellican, Professor of Philosophy;

A.B., M.A., Ph.D., Loyola University

Ellen Michaud-Martins, Adjunct Faculty of Music; B.M., University of Lowell; M.M., New England Conservatory

Barbara Langell Miliaras, Professor of English; A.B., Ed.M., Boston University; Ph.D., Tufts University

Marlowe Miller, Associate Professor of English; B.A., Loyola Marymount University; C.Phil., Ph.D., University of California at San Diego

Arno Minkinen, Professor of Art; B.A., Wagner College; M.F.A., Rhode Island School of Design

Avalon N. Minton, Associate Professor of Political Science; B.A., Wake Forest University; Ph.D. (Cand.) Brown University

Rida M. Mirie, Associate Professor of Mathematical Sciences; B. Sc., American Institute of Beirut (Lebanon); M.Sc., Ph.D., Brown University

Arthur Mittler, Professor of Physics; B.A., Drew University; M.S., Ph.D., University of Kentucky

William F. Moloney, Jr., Associate Professor of Computer Science; B.S., M.S., Lowell Technological Institute

Philip I. Moss, Professor of Regional Economic and Social Development; B.A., John Hopkins University; Ph.D., Massachusetts Institute of Technology

William Moylan, Professor of Music; B.M., Peabody Conservatory; M.M., University of Toronto; D.A., Ball State University

Guntram B. Mueller, Associate Professor of Mathematical Sciences; B.Sc., Loyola College (Montreal); M.S., Ph.D., Notre Dame University

Anne Mulvey, Professor of Psychology; A.B., Barat College; M.A., Hunter College; Ph.D., City University of New York

Charles Nikitopoulos, Associate Professor of Psychology; A.B., Suffolk University; A.M., New School for Social Research; Ph.D., Boston College

Ingul Ivan Oak, Professor of Music; B.M., M.M., New England Conservatory

Arnold L. O'Brien, Professor of Environmental, Earth, and Atmospheric Sciences; A.B., M.S., Syracuse University; Ph.D., Boston University

John Ogasapian, Professor of Music; B.M., M.M., Ph.D., Boston University

Alexander A. Olsen, Associate Professor of Mathematical Sciences; B.S. Lowell Technological Institute; M.S., Northeastern University; Ph.D., Boston College

Thaddeus V. Osmolski, Professor of Biological Sciences; B.S., University of Rhode Island; Ph.D., Brown University

Giampiero Pecelli, Professor of Computer Science; B.A., E. Washington State College; Ph.D., Johns Hopkins University

Melissa M. Pennell, Professor of English; A.B., College of William and Mary; A.M., Ph.D., Brown University

Stephen A. Pennell, Associate Professor of Mathematical Sciences; B.S., Rensselaer Polytechnic Institute; Sc.M., Ph.D., Brown University

Mark Peterson, Adjunct Faculty of Music; B.M., Boston University; M.A., University of New Hampshire

Carolyn Petrosino, Assistant Professor of Criminal Justice; B.S., Howard University; M.S.W., Ph.D., Rutgers University

Marc Phaneuf, Adjunct Faculty of Music; B.M., University of Massachusetts Lowell

Hai B. Pho, Professor of Political Science; A.B., Boston College; A.M., Rutgers University; A.M., Ph.D., Boston University

Michael Pierson, Assistant Professor of History; B.A., Gettysburg College; M.A., Ph.D., State University of New York, Binghamton

Ronald Pickett, Professor of Psychology; A.B., Dartmouth; M.A., Ph.D., University of Michigan

Brenda Pinardi, Professor of Art; B.S. Ed., Massachusetts College of Art; M.F.A., Rhode Island School of Design

Martin Polon, Adjunct Faculty of Music; B.A., M.A. UCLA

Sheryl Lynn Postman, Assistant Professor of Languages; B.A., Rider College; M.A., Ph.D., State University of New York at Albany

Vidhu Prasad, Professor of Mathematical Sciences; B.S., M.S., McGill University; Ph.D., Bryn Mawr College

David J. Pullen, Professor of Physics; B.Sc., London University;

D. Phil., Oxford University

Jean L. Pyle, Professor of Regional Economic and Social Development; B.A., Bucknell University; M.A., University of Michigan; Ph.D., University of Massachusetts

Shelley L. Rasmussen, Associate Professor of Mathematical Sciences; B.S., M.A., Central Michigan University; M.S., Ph.D., University of Michigan

Bodo W. Reinisch, Professor of Environmental, Earth, and Atmospheric Sciences; B.S., M.S., University of Freiburg; Ph.D., Lowell Technological Institute

Ezequiel R. Rivera, Professor of Biological Sciences; B.S., Sul Ross State University; M.S., Purdue University; Ph.D., University of Texas

Kay George Roberts, Professor of Music; B.A., Fisk University; M.M., M.M.A., D.M.A., Yale University

William H. Roberts, Professor of English; A.B., B.S., A.M., Ph.D., Ohio State University

Coleman Rogers, Adjunct Faculty of Music, B.M. Brown University

Juliette N. Rooney-Varga, Assistant Professor of Biological Sciences; B.A., Colby College; M.S., Cornell University; Ph.D., University of New Hampshire

Louis F. Rossi, Assistant Professor of Mathematical Sciences; B.S., Harvey Mudd College, M.A. University of California, Berkeley, Ph.D., University of Arizona

Mary Beth Ruskai, Professor of Mathematical Sciences; B.S., Notre Dame College; M.S., Ph.D., University of Wisconsin

Charles J. Ryan, Associate Professor of English; A.B., University of Connecticut; M.A., University of Massachusetts

David K. Ryan, Professor of Chemistry; B.S., Le Moyne College; Ph.D., University of New Hampshire

Alexander Sachs, Associate Professor of Physics; B.S., Northwestern University; Ph.D., University of New Hampshire

Herlinda Ch. Saitz, Professor of Spanish; Licenciatura, University of Panama; Diplomas de Especializacion, Seminario Andres Bello (Columbia); Ph.D., Boston

University

Alexander Samarov, Professor of Mathematical Sciences; B.S., M.S., Moscow State University; Cand., Academy of Sciences (Moscow)

Daniel Sandman, Professor of Chemistry; B.S., Drexel University; M.A., Ph.D., Princeton University

Rosita Sands, Professor of Music; B.M.Ed., M.A., Florida State University; M.Ed., Ed.D., Columbia University

Ernesto Sanz, Professor of Economics; B.A., Loyola University (Spain); M.A., Kamakura Language College (Japan); M.A., Sophia University (Japan); Ph.D., Boston College

Samuel P. Sawan, Professor of Chemistry; B.S., Ph.D., University of Akron

Walter A. Schier, Professor of Physics; B.S., St. Procopius College; Ph.D., University of Notre Dame

Richard Schilling, Adjunct Faculty of Music; B.F.A., University of Minnesota - Minneapolis; M.M., New England Conservatory

Kunnat J. Sebastian, Professor of Physics; B.S., St. Berchmans College; M.S., University College (India); Ph.D., University of Maryland

Gloria C. Seeman, Associate Professor of Psychology; A.B., City College of New York; M.S., Ph.D., Syracuse University

Nancy Selleck, Assistant Professor of English; B.A., M.A., Columbia University; M.A., Ph.D., Princeton University

Ashot A. Shahinian, Associate Professor of Mathematical Sciences; M.S., State University of Yerevan (Armenia); Ph.D., Steklov Mathematical Institute (Moscow)

John J. Shea, Associate Professor of History; A.B., Harvard College; A.M., Creighton University; Ph.D., Boston University

Thomas B. Shea, Professor of Biological Sciences; B.A., M.S., University of Massachusetts Boston, Ph.D., Northeastern University

Garrett M. Sheehan, Adjunct Faculty in Criminal Justice; B.A., Salem State College; M.S., Northeastern University

John Shirley, Assistant Professor of Music; B.M., The Peabody Conservatory of The Johns Hopkins University; Ph.D., University of Chicago

John Skelton, Adjunct Faculty of Music; B.M., M.M., New England Conservatory

John C. Sieg, Jr., Associate Professor of Computer Science; A.B., Dartmouth College; M.S., University of Lowell; Ph.D., Boston University

Larry J. Siegel, Professor of Criminal Justice; B.A., City College of New York; M.A., Ph.D., State University of New York at Albany

Richard A. Siegel, Associate Professor of Psychology; A.B., Harvard College; M.S., Yale University; Ph.D., Boston University

Balbir S. Sihag, Professor of Economics; B.A., Dayanand College (India); M.A., Punjab University (India); Ph.D., Massachusetts Institute of Technology

Linda Silka, Professor of Regional Economic and Social Development; B.S., Oklahoma University; M.A., Ph.D., University of Kansas

Ilze Skare, Associate Professor of Biological Sciences; B.A., University of Connecticut; Ph.D., Duke University

P. Christopher Smith, Professor of Philosophy; A.B., A.M., Columbia University; Ph.D., University of Heidelberg

Stuart Smith, Professor of Computer Science, B.A., Rutgers University; M.F.A., Brandeis University; Ed.D., University of Massachusetts

Paul E. Snoonian, Associate Professor of Economics; B.S., M.B.A., Northeastern University; M.A., Ph.D., Michigan State University

Peter Spellman, Adjunct Faculty of Music; B.A., Gordon College; M.A., Boston University

Frederick Sperounis, Associate Professor of Sociology; Vice Chancellor for University Relations and Development, B.S.Ed., Salem State College; M.A., Ph.D., Brandeis University

Stanley L. Spiegel, Associate Professor of Mathematical Sciences; B.S., New York University; A.M., Ph.D., Harvard University

Charles A. Steele, Jr., Associate Professor of Computer Science; A.B., M.A., Boston

College; M.S.E.E., Northeastern University

Robert A. Stein, Professor of English; A.B., Clark University; A.M., Ph.D., Brandeis University

Marvin E. Stick, Associate Professor of Mathematical Sciences; B.S., Boston College; M.A., Boston University; Ph.D., Boston College

Richard W. Stimets, Professor of Physics; B.S., Ph.D., Massachusetts Institute of Technology

Thomas Stumpf, Adjunct Faculty of Music; Licentiate, Royal School of Music

Anthony E. Szczesiul, Assistant Professor of English; B.A., M.A., John Carroll University; Ph.D., University of South Carolina

Robert H. Tamarin, Professor of Biological Sciences; Dean of Sciences; B.S., Brooklyn College of the City University of New York; Ph.D., Indiana University

Ruth E. Tanner, Professor of Chemistry; B.S., Purdue University; Ph.D., University of Cincinnati

Paula Telesco, Assistant Professor of Music; B.A., S.U.N.Y. College at Buffalo; M.M., University of Arizona; Ph.D., Ohio State University

David Thibodeau, Adjunct Faculty of Music; B.S., Middle Tennessee State University

Chris Tilly, Professor of Regional Economic and Social Development, B.A., Harvard College; Ph.D., Massachusetts Institute of Technology

W. Anne Trenkamp, Professor of Music; B.A., Ph.D., Case-Western Reserve University; M.M., University of Michigan

Sukant K. Tripathy, Professor of Chemistry; B.S., M.S., Indian Institute of Technology (Kharagpur); Ph.D., Case Western Reserve University

Juanita Tsu, Adjunct Faculty of Music; B.M., Peabody Conservatory of Music; M.M., New England Conservatory

Susan Turcotte-Gavriel, Adjunct Faculty of Music; B.M. University of Massachusetts Lowell

James Veatch, Associate Professor of Art; B.S., State University of New York at Brockport; M.F.A., Rochester Institute of

Technology

Robert B. Wagner, Associate Professor of Philosophy; Provost; B.S., Ohio State University; A.M., Kent State University; Ed.D., Harvard University

Jerry Waldman, Professor of Physics; B.A., M.A., Columbia University; Ph.D., Massachusetts Institute of Technology

Alice Walters, Associate Professor of History; B.S. University of Washington, M.A., Ph.D., University of California at Berkeley

Joseph W. Waterman, Associate Professor of Psychology; B.S., University of Vermont; M.B.A., Boston University; P.Ed., University of Connecticut

Arthur C. Watterson, Jr., Professor of Chemistry; B.S., Geneva College; Ph.D., Brown University

I. Jacob Weinberg, Professor of Mathematical Sciences; B.S., Yeshiva University; M.S., Ph.D., Massachusetts Institute of Technology

Brandon C. Welsh, Assistant Professor of Criminal Justice; B.A., M.A., University of Ottawa; M.A., Ph.D., University of Cambridge

Jon Wheatley, Adjunct Faculty of Music

Robert J. Whelan, Associate Professor of German; A.B., Boston College; M.A., Catholic University of America

James E. Whitten, Assistant Professor of Chemistry; B.S., University of Alabama at Birmingham; Ph.D., Ohio State University

Alan Williams, Adjunct Faculty of Music; B.M., New England Conservatory

Marian Williams, Assistant Professor of Computer Science; A.B., Radcliffe College; M.Ed., Boston University; M.S., University of Lowell; D.Sc., University of Massachusetts Lowell

Martin Wilner, Professor of Physics; B.S., Rensselaer Polytechnic Institute, M.S., Yale University; Ph.D., Massachusetts Institute of Technology

Richard E. Winslow, Assistant Professor of Mathematical Sciences; B.A., Columbia University; M.A., Ph.D., Brandeis University

Chuen Wong, Associate Professor of Physics; Dip. Sci., Chung Chi College

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(Hong Kong); Ph.D., Case Institute of Technology

John C. Wooding, Associate Professor of Regional Economic and Social Development; B.Sc., London School of Economics and Political Science; M.A., Cornell University; Ph.D., Brandeis University

Douglas Worthen, Adjunct Faculty of Music; B.M., B.M.E., Hartt School of Music; M.M., New England Conservatory

Yong Q. Yin, Professor of Mathematical Sciences; B.S., Tsing Hua University (Beijing); Ph.D., University of Pittsburgh

Joseph Zaitchik, Professor of English; A.B., Suffolk University; A.M., Ph.D., Boston University

Engineering is a profession which is concerned with the application of scientific knowledge to the development of technology for the improvement of society. It is involved in the identification of societal needs, the definition of technological problems which address these needs and the creative solutions to these problems in ways that are sensitive to the constraints demanded by society.

James B. Francis College of Engineering

The Francis College of Engineering recognizes that the engineering needs of society are complex and varied as are the diverse interests, motivations, competencies, and backgrounds of its students. Therefore, it has developed a broad spectrum of programs to serve the needs of the student society and the high technology sector of the Massachusetts economy. The emphasis within each engineering program is on technical rigor, utilizing the latest advances in computer technology for the solution of engineering problems. At the same time, each program is characterized by a curriculum that is broad enough to produce engineers who are qualified to meet contemporary demands.

The College has 18 active chapters of professional engineering societies, including the National Society of Black Engineers and the Society of Women Engineers. In addition, it has a Chapter of Tau Beta Pi, the national engineering honor society. Student participation in these societies is encouraged.

A review course is offered in cooperation with the Massachusetts Society of Professional Engineers for students planning to take the Fundamentals of Engineering (F.E.) examination. The College serves twice a year as host for the examination which is a requirement for registration as a professional engineer. Students are strongly urged to take the F.E. examination at the appropriate time.

Krishna Vedula, Dean

Gil Brown, Asst. to the Dean

Sam Mil'shtein, Asst. to the Dean

Ralph L. Mondano, Executive Asst. to the Dean



Shared Vision of the Francis College of Engineering

We, the faculty, staff, and students of the Francis College of Engineering are strongly committed to providing to our students the highest quality of "Learning" which is relevant to the needs of the industry and society. We will do this in an atmosphere that truly cares about the needs of our customer, the student, and in a spirit of cooperation among our faculty, staff, and students.

Objectives of the Francis College of Engineering

The Francis College of Engineering seeks to prepare men and women for their entrance into the engineering profession in anticipation of their becoming leaders in industry, government, and education. Programs in the College of Engineering have been structured to permit students the option of entering the practice of engineering immediately after attaining an undergraduate degree or to delay entrance to the profession until they have attained a graduate degree.

Programs are available in several engineering disciplines to accommodate varied interests. In addition, within each discipline students may prepare for various careers such as research, development, design, production, construction, teaching, and management. A faculty advisor is assigned to each student to provide experienced guidance in selecting programs and courses and in career planning.

Each student is encouraged to develop his or her full potential as an engineer with a high degree of awareness of the technological needs of society, the nation, and particularly those of Massachusetts industry, government, and educational institutions.

The College stresses professional needs by continuously updating courses and options in the standard engineering and selected specialty programs. The departments use all available resources to advance the level of excellence of their

programs. Standards are monitored by the Engineering Accreditation Commission and the Technology Accreditation Committee of the Accreditation Board of Engineering and Technology (ABET). Departments adhere to the standards of the National Society of Professional Engineers. The college also follows the careers of successful graduates, and solicits their views on making programs more relevant and effective.

In each discipline, the College of Engineering offers graduate research programs which not only serve as a source of updating the undergraduate course offerings, but also ensure that faculty are on the cutting edge of their particular disciplines. These programs advance the general level of information and knowledge that is so essential in fast-moving technological fields, while providing the highly specialized research required by industry. By functioning as an educational resource to the engineering profession and industry of the Commonwealth through instruction, consulting services, and research, the College of Engineering at the University of Massachusetts Lowell provides its students with an ever-current view of the working world for which they must prepare.

The College offers a Division of Continuing Education program in the evening leading to associate and baccalaureate degrees in engineering technology. The Division of Continuing Education provides men and women an opportunity at the associate, undergraduate, and graduate degree levels to further their preparation for careers.

College Organization and Governance

The College of Engineering is organized into seven departments: Chemical and Nuclear Engineering, Civil & Environmental Engineering, Electrical & Computer Engineering, Mechanical Engineering, Plastics Engineering, Work Environment, and Engineering Technology. While focusing on their respective special fields of study, the departments share many common inter-

ests in engineering, science, the humanities, and social sciences. Students may declare a major in a specific program, or begin as undeclared majors. All students take courses in and outside the College.

The College is administered by a dean. As the chief academic and executive officer, it is the Dean's responsibility to formulate goals and objectives for the College within the context of the University mission and to implement programs of high academic quality to attain these goals. The Dean is assisted by two senior faculty members. The Engineering Academic Council of the College and the Industrial Advisory Board in each of the professional areas support the College and the departments in monitoring academic standards and in ensuring the current relevancy of the curriculum.

Each department is administered by a department head. Each is responsible for developing its own course offerings. The engineering faculty as a whole is responsible for all academic policies of the College.

The ability to communicate ideas clearly, concisely, and accurately is vital to our graduates' success as practicing engineers. The UMass Lowell Engineering faculty expects them to compete both technically and professionally with those from the best engineering schools in America. Mathematical skills and communication skills are required for a successful engineering education and career. All freshman engineering students are evaluated to determine the proper starting points for mathematics and English. Placement is determined by an evaluation of a special College Board Test taken before school starts, their SAT scores, rank in high school class, and mathematics courses taken in high school. This allows for an initial placement into a suitable calculus sequence which will increase their chance for success in the engineering curriculum.

The Centers for Learning and Academic Support Services (CLASS) support the College of Engineering's retention and academic programs by providing a comprehensive network of academic services that enable both faculty and students to excel

in teaching and learning. These include peer tutoring, computer assisted learning, advising, early academic evaluations, and workshops on time management, note taking, and textbook reading.

In addition, Project Restart is a program for freshmen who were suspended after their first semester at UMass Lowell. It allows the students to start over while learning the skills that are necessary to be a better student.

Center for Women in Engineering and Science

The Center for Women in Engineering and Science provides a supportive and inclusive environment for women pursuing careers in engineering and science. It provides pathways to resources and services available on campus as well as in government and the private sector. The Center will also provide opportunities to network with industry and to help prepare women for entry into academic and industrial careers. The Center creates an environment for women students to support each other and to network among themselves.

Engineering Academic Council

The Engineering Academic Council, consisting of the Dean, the two faculty assistants to the Dean, and department heads representing each department, is responsible for enforcing academic standards of the College and establishing and enforcing disciplinary procedures. This committee also serves as a review body for suspended students seeking readmission to the College. Members of the committee are:

William Moeller, Civil & Environmental Engineering, Chairperson

Alfred Donatelli, Chemical and Nuclear Engineering, Chairperson

Struan Robertson, Mechanical Engineering, Chairperson

Donald S. Pottle, Engineering Technology, Chairperson

Michael Fiddy, Electrical & Computer Engineering, Chairperson

Robert E. Nunn, Plastics Engineering, Chairperson

David Wegman, Work Environment, Chairperson

Krishna Vedula, Dean

Gilbert Brown, Asst. to the Dean

Sam Mil'shtein, Asst. to the Dean

Ralph L. Mondano, Executive Asst. to the Dean

Industrial Advisory Boards

Each engineering program is supported by an Industrial Advisory Board composed of industrial leaders. This Industrial Advisory Board supports the College and the departments in formulating new curricula and in keeping programs up to date with rapidly advancing high technology. These boards serve to promote a high degree of interaction between the College and the manufacturing industry and regional economy which it primarily serves. In addition, the College has an Industrial Advisory Board that considers broader issues relative to the continued development of all the engineering undergraduate and graduate programs in keeping with the University's mission.

Engineering Student Council

The Engineering Student Council consists of students selected to represent each of the engineering disciplines. Typically, the Council consists of 15 E-Council Fellows who represent the "Voice of the Customer: the Student." Members of the Council maintain an office and meet regularly to help engineering students, particularly freshmen. The Council has direct and regular access to the Dean and allows the Dean to stay in touch with the concerns of the students. The Council also helps the Dean plan and implement important College eEvents during the year.

Undergraduate Degree Programs

The College of Engineering offers four-year undergraduate programs leading to the degree of Bachelor of Science in Engineering; a four-year undergraduate program leading to a degree in Industrial Technology; programs leading to Associate and Bachelor of Science in Engineering Technology (in evening part-time programs), five-year dual-degree programs with the College of Arts and Sciences leading to a Bachelor of Science degree in Engineering and a Bachelor of Arts, and five-year programs leading to both Bachelor of Science in Engineering and Master of Science in Engineering.

The degree of Bachelor of Science in Engineering is offered in the following fields: Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering and Plastics Engineering. Course requirements for engineering degrees have been determined by specific professional objectives and are subject to the recommendations of the Engineering Accreditation Commission, and the Accreditation Board for Engineering and Technology (ABET). All engineering programs are accredited by the Engineering Accreditation Committee (EAC).

The degree of Bachelor of Science in Engineering Technology is awarded in the areas of Civil Engineering Technology, Electronic Engineering Technology, and Mechanical Engineering Technology, offered in the evenings through the Division of Continuing Education. The Civil, Electronic and Mechanical Engineering Technology degrees are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Courses of study in engineering and engineering technology provide a basic general education, scientific-technological preparation in the sciences, and a comprehensive introduction to an engineering or technology field. Students must select a single major field of study. However, can-

didates for degrees in the College of Engineering may be permitted to elect additional majors in other colleges of the University, provided that all curriculum requirements for their degree program in the College of Engineering are satisfied. Although the Department of Work Environment offers degrees only at the graduate level, it offers courses at the undergraduate level and combined BS/MS degrees with a number of engineering programs.

Cooperative Education Program

The newly started Cooperative Education program for undergraduates combines academic studies with work experience in appropriate positions in the public or private sectors. It permits students to participate in a flexible schedule of study and work that is related to their academic fields of study and to receive academic credit for the work experience.

All engineering students may participate in this program following completion of the freshman year and at least one full academic semester in good academic standing at UMass Lowell. It enables a student to work in industry and to complete a baccalaureate program in five years.

The Cooperative Education program in Engineering is administered by the Dean in collaboration with the Director of Career Services and assisted by a College Coop Coordinator and individual departmental coordinators.

Dual Degree Program with other Colleges (3+2 plan)

A formal "3+2" engineering program is jointly offered by St. Anselm College, Gordon College, and the University of Massachusetts Lowell. This program enables a student to gain both a liberal arts education and a professional engineering education, earning a Bachelor of Arts degree from St. Anselm College or Gordon College usually at the end of the fourth year, and a Bachelor of Science Degree in Engineering from the University of Massachusetts Lowell. Students in this program will enter St. Anselm College or Gordon College and study for three years,

gaining a broad liberal arts education combined with the necessary math/science foundation courses. These students then enroll at the University of Massachusetts Lowell for two additional years, completing a professional BS engineering program.

Combined Bachelor of Science in Engineering/Master of Science in Engineering Degrees Program (five-year plan)

In order to encourage outstanding undergraduate students to continue their studies toward an advanced degree, the College of Engineering and the Graduate School offer a program of accelerated study which leads to a Bachelor of Science in Engineering/Master of Science in Engineering degree. Students taking full advantage of the combined program ordinarily finish the Master of Science in Engineering degree at the end of the fifth year of study.

To be eligible to enter this course of study, a student must file a formal Graduate School application in the junior year. Applicants for this program are not required to take the Graduate Record Examination. Upon recommendation of the student's advisor and with the approval of the department graduate admissions committee and the Dean of the Graduate School, the student may be admitted as a provisional graduate student during the second semester of the senior year.

Certain graduate or advanced undergraduate (400 level) courses that an undergraduate in this program takes during the senior year may be used to satisfy both the graduate and undergraduate degree requirements within a limit of credits established for each department.

A student in this program may be eligible for financial assistance, i.e., fellowships and teaching assistantships, during the fifth year of study. Acceptance of this assistance and the attendant responsibilities may delay the completion of the program beyond the five years.

Graduate Programs

The education of engineers in state-of-the-art areas of advanced technology and the University's commitment to national and regional economic development are the major premises upon which the graduate programs in the College of Engineering are based. These programs are intended to produce engineers whose education not only develops expertise in the design, development and production of products, but also an understanding of the management involved in the creation of new products, companies, and service organizations. Thus, the graduate programs in engineering are intended to educate engineers capable of keeping abreast with the rapidly changing technology that characterizes the high technology economy of the Northeast. The programs lead to degrees of Master of Science in Engineering, Master of Science, Doctor of Science, Doctor of Philosophy, and Doctor of Engineering.

General College of Engineering Requirements

Each candidate for the undergraduate degree must satisfy the general requirements of the University of Massachusetts Lowell in order to graduate. The student must also meet the specific academic requirements of the College of Engineering as indicated in this section, as well as complete all credits and courses required by the department in which the student majors. The number of credits required for the completion of each College of Engineering program is established by the department offering the program.

Courses taken by freshmen entering any engineering discipline are for the most part similar and include calculus, physics, chemistry, college writing, and engineering design.

Introduction to Engineering (25.107 and 25.108) introduces freshmen to the computer skills and the engineering design process as the method engineers use to solve open-ended problems. Topics include: How to identify a problem, How to develop alternative solutions, How to

select the best alternative, How to make ethical decisions, and How to work as a team. Students in these courses participate in a variety of design projects depending on their anticipated choice of major. The computer skills introduced include the use of the VAX mainframe computer and IBM-compatible PCs, software packages for use with arrays and matrix algebra, statistics, and mechanical drawing.

Students who have completed their freshman programs with a grade-point average of 2.50 or better automatically qualify for admission to the sophomore program of their choice. Students who fail to achieve that required average will be admitted to the sophomore year of engineering programs only upon the recommendation of appropriate departmental committees.

Please refer to the University grade-point average policy for satisfying retention and graduation requirements.

Individuals who are not granted continued matriculation in the College of Engineering but who satisfy University retention requirements may file for intercollegiate transfer within the University. Students who are dismissed from the College of Engineering and who are ineligible to file for intercollegiate transfer or who are denied admission to another college following application for intercollegiate transfer are dismissed from the University.

Professional Programs of Study

Students who are enrolled in the College of Engineering may declare a major in one of the established degree-granting programs, or may begin as "undeclared" majors and choose a degree major within the first two years.

Change of Program

Students who wish to change their declarations of program within the College of Engineering are required to follow the procedure stipulated in this catalogue under "University Academic Policies: Change of Major within College of Enrollment." It should be noted that College of

Engineering students who change their programs within the College of Engineering after the first semester of the sophomore year should expect to have to take semester credits beyond the minimum degree requirement, and thus extend the normal four-year period of study.

Students who wish to change from engineering to a major which is offered by another college within the University of Massachusetts Lowell must apply for an intercollegiate transfer. These procedures are described under "University Academic Policies: Change of Major with Intercollegiate Transfer."

Qualified students from other colleges in the University of Massachusetts Lowell may transfer into degree programs of the College of Engineering using the same procedure. However, these students may expect to extend their period of study beyond the normal four-year period, particularly if they transfer after the first semester of the sophomore year.

Declaration of Second Major

Candidates for degrees in the College of Engineering may be permitted to elect additional majors offered in other colleges of the University, provided that all curriculum requirements in engineering are satisfied.

Engineering students who wish to take on a second major which is offered by the College of Engineering or by another college must formalize this intent by the start of the junior year. At that time the student is also required to submit for approval his or her intended program of study to the advisor in the department offering the second major. It should be noted that in most cases, the election of an additional major will extend the normal four-year period of undergraduate study. Students who elect to take a second academic major in another college are candidates for one degree in the College of Engineering only. A student who pursues an academic major in the College of Engineering and another college or two majors in the College of Engineering is subject to all degree

requirements of the College of Engineering and is subject only to major course requirements specified by the department of the secondary major. For a complete statement of University Policy on double majors, refer to "University Academic Policies: Major Field Requirements," which appears elsewhere in this catalogue.

Transfer Policies of the College of Engineering

General Policies

It is the policy of the College of Engineering to accept transfer students from other institutions as well as from other colleges within the University of Massachusetts Lowell. Such students may expect recognition of previously completed courses if these are equivalent to those which are specified by the curricula of the College of Engineering. Transfer students are required to have at least a 2.5 grade-point average in order to be admitted to the College of Engineering.

Transfer from Other Institutions

UMass Lowell participates in the Joint Admissions Program of the Massachusetts Community Colleges and the University of Massachusetts. According to this program, a student from one of these community colleges is guaranteed admission to UMass Lowell provided the student is enrolled in a designated transfer program and earns an associate degree with a 2.5 or higher cumulative grade point average.

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University of Massachusetts Lowell requirements. Professional courses are subsequently evaluated by the departments in which the student has been accepted. Credit is given for completed courses where the grade is C (2.000 on a 4.000 scale) or better.

The University of Massachusetts Lowell also subscribes to the Commonwealth Transfer Compact. Under this compact, the holder of an associate degree from a compact institution receives up to 66 credits for this work toward a Bachelor of Science in engineering or technology.

Courses which are transferred to the University of Massachusetts Lowell under the provisions of the Commonwealth Transfer Compact, but which do not meet the credit requirements of the College of Engineering, or which are not acceptable as unrestricted elective courses, will be listed on the student's transcript, but will not apply to the minimum degree requirements.

In the event that a student has first transferred to some other college in the University of Massachusetts Lowell under the Commonwealth Transfer Compact and subsequently makes a transfer to the College of Engineering, all previously completed courses, including transferred courses from other compact institutions, will be re-evaluated in terms of their applicability toward degree requirements of the College of Engineering.

The policies of each of the colleges in the University determine the applicability of grades received in transfer to the grade-point average of the student's major at the University of Massachusetts Lowell. It is the policy of the College of Engineering not to count such grades for the purpose of determining the student's grade-point average in his or her professional area.

2 + 2 and 2 + 3 Transfer Programs

The College of Engineering has been a leader in the development and implementation of 2 + 2 and 2 + 3 Programs in the Commonwealth of Massachusetts. More and more students who are interested in earning a Bachelor of Science degree in one of the engineering disciplines pursue their first two years of the curriculum at selected community and state colleges and complete the degree requirements during two to three final years at the University of Massachusetts Lowell. The program is ideal from the standpoint of the student who is not ready to enter a four-year college, allowing the participant to ease into college life while still remaining close to home and within the environment of a smaller college.

The contractual agreements among participating schools require an on-going review of coursework normally offered in the first two years. Curricula and other requirements are carefully established and examined by faculty at both institutions.

Transfer agreements vary with each institution participating in the 2 + 2 or 2 + 3 programs. Some participating colleges offer programs which prepare students for transfer to mechanical and electrical engineering; programs in other schools lead to entry into chemical or civil engineering. High school students who are considering this program should consult the office of admissions at the University of Massachusetts Lowell for information about available programs in participating institutions.

Repetition of Transferred Courses

A student who has been granted transfer credit from another institution, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be subsequently advised to repeat such transferred work at the University of Massachusetts Lowell. Such cases arise when preparation of the student is demonstrably inadequate to allow successful performance.

To repeat a transferred course a student must file an academic petition with the Dean of the College. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a "request to revoke recognition" statement to dispose of the previously transferred course credit.

Intercollegiate Transfer to the College of Engineering

Students wishing to transfer to the College of Engineering from another college within the University of Massachusetts Lowell, or from a baccalaureate (degree granting) Division of Continuing Education program must file a form for change of major together with a transcript, with the Dean of the College of Engineering and with the appropriate engineering department head.

Petitions for transfer must be filed no later than November 1 in order to transfer in the spring semester, and no later than April 1 in order to transfer in the fall semester.

Any student who wishes to transfer from another college in the University to the College of Engineering must have a minimum grade-point average of 2.500. Irrespective of the grade received, all courses which may not be applied to the College of Engineering program requirements will be deleted from the student's cumulative grade-point average.

For further procedural details about the University's policies concerning intercollegiate transfers, students are referred to "University Academic Policies: Change of Major with Intercollegiate Transfer," elsewhere in this catalogue.

College of Engineering: Course Prefix Codes

The University uses a prefix number for each program of study.

Course prefixes assigned by the College of Engineering are as follows:

Chemical Engineering	10
Civil Engineering	4
Civil Engg Technology	15
Electrical Engineering	16
Electronic Engineering Technology	17
Work Environment	19
Mechanical Engineering	22
Mechanical Engg Technology	23
Nuclear Engineering	24
Intracollegiate Courses	25
Plastics Engineering	26

Intracollegiate Engineering Courses (Course Prefix: 25)

25.107 Introduction to Engineering I
This course is intended for freshmen in all engineering majors, as well as others who would like to develop their basic computer skills. It provides a variety of computer skills common to all of the engineering disciplines. Students learn how to access the Internet and the WWW, and how to send and receive messages via E-mail. Software packages for use with arrays,

complex numbers and matrix algebra, statistics, and mechanical drawing are introduced. This is followed by four weeks of instruction in a high-level computer language, and two weeks of a modern graphical programming language. Applications include graphing data, curve fitting, and solution to sets of equations. Exposure to word processing and spreadsheets is provided as well.

25.108 Introduction to Engineering II

This course is intended for freshmen. It provides hands-on introduction to the engineering design and manufacture process via four-week modules in specific engineering disciplines. Attention is paid to the importance of quality, communication skills and the engineering design process as the method engineers use to solve open-ended problems. Topics include: How to identify a problem, How to develop alternative solutions, How to select the best alternative, How to make ethical decisions, and How to work as a team. Students participate in one of a variety of design projects depending on their anticipated choice of major. The course also provides an overview of job and coop opportunities in different engineering disciplines and strategies for success in school.

25.110 Engineering Seminar

This course is required during the first semester of all freshmen entering engineering programs. It provides the students help with strategies for success in studying engineering. Students will be given advice, mentored, and provided tips for dealing with courses and time management. Peer student advisors, faculty advisors and mentors from industry will be available at different times during the semester. Presentations by engineers from industry will help freshmen students obtain a glimpse of the profession they have chosen.

25.225 Technical Communication for Engineers

Provides students with the knowledge and skills to communicate successfully through presentations and written documents. The thoughts to be transferred are examples of business and technical subjects. Various forms of technical/business communications are addressed. These include the memorandum, the business letter, the proposal, the résumé, the lab

report, the major report, and the oral presentation.

Department of Chemical and Nuclear Engineering

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Alfred A. Donatelli, Chairperson

Thomas Vasilos, Coordinator for Chemical Engineering Graduate Program

Gilbert J. Brown, Coordinator for Nuclear Engineering (Option and Minor)

Undergraduate Program and Energy Engineering (Nuclear Option) Graduate Program

Professors: Francis J. Bonner, Gilbert J. Brown, Alfred A. Donatelli, James R. Sheff, Thomas Vasilos, John W. Walkinshaw and John R. White.

Associate Professors: Changmo Sung and Randall W. Swartz.

Assistant Professor: Carl W. Lawton

The Department of Chemical and Nuclear Engineering offers undergraduate programs leading to the B.S. degree in Chemical Engineering, as well as Master's and Doctoral programs in Chemical Engineering, Materials Engineering and Energy Engineering (Nuclear Option).

The undergraduate program has the objectives of providing a broad, fundamental base from which graduates are well equipped for a wide variety of positions as practicing chemical engineers or for graduate studies in competitive engineering and scientific disciplines. To achieve this, the program provides the knowledge, skills and resources for continued learning and professional development over a lifetime. The program emphasizes its strength in processing and manufacturing and draws on the scholarly accomplishments of its faculty to integrate traditional chemical engineering top-

ics with specialized studies in the contemporary fields of process controls, paper, materials, energy and bioprocessing.

The undergraduate program requires courses in basic sciences and mathematics. These provide a firm understanding of fundamentals, help the student develop analytical techniques, and serve as the basis for specialized engineering courses.

A second component consists of courses that serve as an introduction to engineering, link the basic sciences and engineering, and introduce engineering analysis, synthesis and design.

General education courses in the social sciences and humanities are woven throughout the curriculum. These broaden perspectives, maintain and improve communication skills, and sensitize engineering students to concepts of values and ethics.

The curriculum emphasizes the study of advanced problems and topics in engineering design. The purpose is to develop skills in the use of science, sensitivity in the application of ethical considerations, sensibility in economic matters, and creativity in solving engineering problems.

Laboratory work and computer applications are extensive in the program.

Throughout the undergraduate program, the Department aims at helping the students to develop a command of generic computational tools. In the first year, students learn programming for personal computers, operation of networked computer systems, and the basics of computer aided design. In the second year, they learn the common numerical methods encountered in the solution of chemical and nuclear engineering problems. Thereafter, most courses utilize computational methods and tools to solve problems and explore new frontiers in chemical and nuclear engineering; throughout, the computer is viewed as a tool available to the effective engineer.

The Department graduates engineers who are expected to have a knowledge of chemical and nuclear transformations and their productive uses in society. They are also expected to have an understanding of the ethical, social, economic, and safety considerations of good engineering practice.

Members of the faculty are active in research aimed at increasing thermal efficiency and decreasing any adverse environmental impact in the chemical and nuclear industry. In power generation, the Department is looking at advanced nuclear designs and alternatives which minimize environmental emissions.

Advanced courses in power systems are offered regularly. New offerings in areas such as space nuclear applications, biotechnology, and engineered materials are developed and offered based on the needs and interest of the faculty and students.

The computational facilities and the expertise of the faculty make it possible for the students to look in depth at system controls and at engineering modeling and simulation. They also learn to apply computational methods to the numerical solution of transport equations.

The undergraduate curriculum is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

Five Year Bachelor of Science/Master of Science in Engineering Program

The Department offers a special five year program which makes it possible for qualified students to complete the requirements for the B.S. degree and the M.S. degree in five years. During the first three years, the course work under this program is the same as that specified for students in the four year bachelor program. In the junior year, students with at least a 3.00 cumulative grade point average may be admitted into the B.S./M.S. program. Those students will normally take two or

three graduate-level courses in their senior year, which may be counted for both the undergraduate and the graduate degrees. This gives them a six to nine credit head start on their M.S. program in Chemical, Materials, or Energy Engineering, which normally can be completed in the fifth year.

Financial Support and Professional Activities

There are different sources of support for students in the Department to enhance their professional development. A number of scholarships are available to qualified students in chemical engineering, in the paper engineering option, and in the nuclear engineering option. A tuition waiver is available to qualified Massachusetts residents.

Undergraduates are encouraged to gain practical experience and are directed to employment in industry. Through a Cooperative Education Program, it is possible for an undergraduate student to integrate productive work experience with academic studies. Because of constraints imposed by course prerequisites and departmental offerings, however, work intervals of less than nine months must be carefully planned by the student with the help of the advisor. Part time or summer work experience opportunities are available as well. The department also encourages students to take the Fundamentals of Engineering examination.

Program in Chemical Engineering

Alfred A. Donatelli, Program Coordinator

Thomas Vasilos, Graduate Coordinator

While the undergraduate program in Chemical Engineering maintains its traditional role to educate students for employment in the chemical processing industries and to prepare them for advanced work at the graduate level, the curriculum highlights new applications

especially in industries of regional importance.

Chemical engineering is a dynamic profession: there are frontiers with exciting opportunities in traditional areas as well as in new fields. Very early in the program, students are exposed to the frontiers of chemical engineering, such as microstructured materials (biotechnology and biomedicine), and go on to considerations of liquid fuels, recycling, smart materials, environmental remediation, and colloids.

Established features of the local economy are the vigorous entrepreneurial and high tech industries that both reflect and lead national trends and that are especially pertinent to emerging trends in chemical engineering. This presents a timely opportunity to the Department to contribute significantly both in the progress of our local and national economies and to the progress of the profession.

Examples of some of the on-going projects include:

Bioprocessing and Bio-Materials

Research in the areas of bioprocessing and bio-materials is expanding. Large scale bio-manufacturing constitutes a major Departmental interest. The Massachusetts BioProcess Development Center, based at the University, serves as an incubator for the biotechnology industry and aids early stage companies with process research and preparation of test materials. Research in collaboration with the Center for Chronic Disease Control is focused on the novel processing of natural materials in order to retain health promoting properties. Several new food ingredients have been developed that will lower blood cholesterol levels, which is an important risk factor in cardiovascular disease.

High Temperature Composites and Materials Characterization

Research and teaching in high temperature ceramics and materials characterization are on-going. There is an emphasis on materials courses, from a basic introduction to materials to several advanced

courses in ceramics, composites and materials characterization. A high temperature hot press for the processing of advanced high temperature composites, combined with air atmosphere sintering furnaces and milling equipment, provide an overall ceramic and composite materials processing facility. The Center for Advanced Materials at the University has a state-of-the-art facility for characterizing the structure of engineered materials.

Colloid and Interfacial Science and Engineering Program

The Department has an on-going effort in colloidal and interfacial science and engineering directed toward improving processes and products related to composites, ceramics and bio-medical materials. Courses on colloids and interfacial science and engineering are regularly offered. Examples of on-going research work include studies involving suspension polymerization, hydrogels, and non-aqueous gels of preformed colloidal particles.

Sustainable Technologies

The University of Massachusetts Lowell has taken a leading regional role to advance the investigation, development and evaluation of sustainable technologies that are environmentally, occupationally and economically sound. Important research is being done in several departments of the University, in cooperation with the Toxic Use Reduction Institute and the Center for Environmentally Appropriate Materials at the University.

Complementing those efforts, traditional strengths in the areas of separations technology and paper engineering have expanded research in recycling and waste minimization. Courses in advanced separation processes and paper engineering are offered.

Drawing from a strong background in paper manufacturing, evaluation, and recycling, the eventual goal is to establish in the Department a regional center of excellence for paper recycling.

The Nuclear Engineering Option

The Department offers a formal option in Nuclear Engineering with a focus on nuclear processes and technology and on

nuclear electric power generation. The option consists of a sequence of four courses that are specifically designed for engineering majors. The option gives concentrated training in a variety of nuclear technologies. Engineering graduates with the Nuclear Engineering Option can help the nuclear industry face current and future technical challenges in areas such as the safe disposal of nuclear waste, continued safe and economical operation of existing nuclear power plants and processing facilities, improved plant performance, design of new facilities, and other advanced industrial and medical applications of nuclear technology.

The Paper Option

The Department offers the chemical engineering student a formal option in paper engineering, and several courses are taught on paper and paper-like materials.

As the demand for paper and paper products continues to grow, concerns about deforestation and waste have prompted legislation at both the state and federal levels requiring minimum recycle fiber contents in many consumer grades of paper. There is a particular interest in exploring the expanded use of recycled cellulose waste fibers in commercial and industrial products and in the evaluation of the properties of paper and paper products. The Department has nationally recognized expertise in determining recycled fiber content.

Concentration In Biochemical Engineering

The Department offers a concentration in biochemical engineering designed to help prepare the student for work in the biopharmaceutical or biotechnology industry. The student takes specified biology courses, 81.111 or 81.201, in the fall of the sophomore year and 81.548 in the junior year plus 10.535 and 10.545 in the senior year. The completion of two additional courses may also qualify the student for the Graduate Certificate in Biotechnology and Bioprocessing (see graduate catalog for details).

Concentration In Engineered Materials

The Department offers a concentration in engineered materials so that the student can develop a specialization in that area. Courses are taught in ceramics, paper and polymeric materials, as well as in advanced materials characterization methods.

Concentration in Computer-Aided Process Controls

The Department offers a concentration in computer-aided process controls in which students can develop a specialization in that area. Courses are taught on the hardware and software aspects of computer control and advanced methods of chemical process design, analysis and control.

Nuclear Science and Engineering Minor

Students majoring in most fields of science and engineering should have the required background to pursue a minor in the area of Nuclear Science and Engineering. Graduates with some focused training in the nuclear area can help the nuclear industry face current and future technical challenges.

The Nuclear Science and Engineering minor consists of 18 credits of required course work that follows one of two tracks. Three core courses are common to both tracks and form the basis of the nuclear focus. The remaining three courses for the minor are taken from either a Science or an Engineering track.

Interaction with Industry

The Chemical and Nuclear Engineering Programs work closely with an Industrial Advisory Board, which meets regularly to advise on matters relating to program modifications and assessment and external relations and development.

Professional Activities

Chemical Engineering students have the opportunity to join the student chapter of the American Institute of Chemical Engineers and/or the student chapter of the Technical Association of the Pulp and Paper Industry. Students in the Nuclear Engineering option have the opportunity

to join the student chapter of the American Nuclear Society. Local chapters of the Chemical Engineering Honor Society, Omega Chi Epsilon, and the Nuclear Engineering Honor Society, Alpha Nu Sigma, are open to qualified students.

Course of Study in Chemical Engineering (Bachelor of Science in Engineering)**Required for 2003 Graduates and Those Following****Freshman Year****First Semester**

25.107	Intro to Engineering I	2
25.110	Engineering Seminar	0
42.101	College Writing I	3
84.121	Chemistry I	3
84.123	Chemistry Lab I	1
92.131	Calculus I	4
95.141	Physics I	3
96.141	Fund Exp Physics I	1
		17

Second Semester

25.108	Intro to Engineering II	2
25.110	Engineering Seminar	0
42.102	College Writing II	3
84.122	Chemistry II	3
84.124	Chemistry Lab II	1
92.132	Calculus II	4
95.144	Physics II	3
96.144	Fund Exp Physics II	1
		17

Sophomore Year**First Semester**

10.203	Chem Eng Calc I	3
10.217	Computer Applications	3
92.231	Calculus III	4
	Gen Education Elective(1)	3
	Gen Education Elective(1)	3
		16

Second Semester

10.204	Chem Eng Calc II	3
10.206	Fluid Mechanics	3
84.344	Physical Chemistry I(2)	3
92.236	Eng Differential Equations	3
	Gen Education Elective(1)	3
		15

Junior Year**First Semester**

10.305	Heat Transfer	3
10.308	Engineering Materials	3
10.315	Unit Operations Lab I	2
84.221	Organic Chemistry I(3)	3
84.345	Physical Chemistry II	3
84.347	Physical Chem Lab II	1
	Gen Education Elective(1)	3
		18

Second Semester

10.306	Transport Phenomena	3
10.310	Separation Processes	3
10.311	Thermodynamics	3
10.316	Unit Operations Lab	2
84.205	Organic Chem Lab	1
84.222	Organic Chemistry II(3)	3
	Gen Education Elective(1)	3
		18

Senior Year**First Semester**

10.403	Reactor Design	3
10.409	Eco & Process Analysis	3
10.413	Process Dyn & Control	3
10.—	Chemical Eng Elective(4)	3
	Tech Elective(4)	3
		15

Second Semester

10.410	Plant Design	3
10.416	Process Operations Lab	2
10.—	Chemical Eng Elect.(4)	3
	Tech Elective(4)	3
	Gen Education Elective(1)	3
		14

Total credits: 130

(1)The University General Education requirements must be satisfied. Either Economics I or II must be used to satisfy one of the Behavioral and Social Science requirements. An Ethics course must be used to satisfy the Values, Concepts and Choice requirement.

(2) Listed corequisite, 84.346, Physical Chemistry Lab, is not required for Chem. Eng. (CN) majors.

(3)Listed corequisite, 84.229 or 84.230, Organic Chemistry Laboratory is not required for CN majors.

(4) These elective courses combined must have some engineering design content.

Chemical Engineering (Course Prefix: 10)

10.203 Chemical Engineering Calculations I

Introduction to the field of chemical engineering and solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships. Prerequisite: 84.122. (3)

10.204 Chemical Engineering Calculations II

Continuation of Chemical Engineering Calculations I including real gas relationships, humidity, energy balances, and the combined mass-energy balance systems. Prerequisite: 10.203. (3)

10.206 Fluid Mechanics

Treatment of the fundamentals and applications of fluid mechanics: laminar and turbulent flow in conduits and past immersed bodies, flow measurement, pumps, turbines, mixers. Prerequisite: 92.231. (3)

10.217 Computer Applications in Engineering Design

An introduction to computers as a problem solving and communications tool and to applied numerical methods. Topics such as roots of equations, systems of linear equations, curve fitting, numerical integration, ordinary differential equations, etc., are treated with an emphasis on applications. Good computer programming skills are emphasized using the Matlab language. Good communication skills are also stressed. Prerequisite: Some minimal prior computing experience and a general working knowledge of a programming language are assumed. Mathematics background should include two semesters of Freshman calculus. Prerequisite: 92.132. (3)

10.305 Heat Transfer

Fundamental principles of heat transmission by conduction, convection, radiation and evaporation. Applications of these principles to the solution of industrial heat transfer problems and to the design calculations for heat exchange situations. Prerequisite: 10.204. (3)

10.306 Transport Phenomena

Introduction to the theory of the transport

processes. Integral and differential approaches are used to develop the macroscopic and microscopic forms of the conservation laws. The conservation laws are used to solve practical problems in the chemical and nuclear industry. Prerequisite: 92.236. (3)

10.308 Engineering Materials

A general overview of solid materials which are likely to be considered for engineering applications in, or be produced by the chemical process industries. They will be discussed from the viewpoints of their units structures, appropriate phase diagrams, their chemical and physical attributes, and the association of these to end use applications. Discussion of metals, ceramics, polymers, and to a limited degree, composites. Prerequisite: junior standing or permission of instructor. (3)

10.310 Separation Processes

Introduction to equilibrium staged and other separations, including distillation, adsorption, absorption, membrane and chromatographic based separations. Unifying fundamental relations and concepts are emphasized. Prerequisites: 10.206, 10.305, 92.231. Corequisite: 10.311. (3)

10.311 Engineering Thermodynamics

Development of the first and second laws of thermodynamics, P-V-T relations, mathematics of property changes, generalized correlations of thermodynamic properties, application of thermodynamics to problems of phase and chemical equilibria. Prerequisite: 92.231. (3)

10.315 Unit Operations Laboratory I

Experimental projects treat fluid flow and heat transfer in a unit operations format. Experimental design and use of laboratory resources discussed. Written reports required. Prerequisite: 10.206. Corequisite: 10.305. (2)

10.316 Unit Operations Laboratory II

Experimental projects treat heat and mass transfer, including staged operations, in a unit operations format. Process measurement and calibration emphasized. Written reports required. Prerequisite: 10.315. Corequisite: 10.310. (2)

10.331 Introduction to Nuclear Engineering I (same as 24.331)

Review of relevant nuclear physics topics including nuclear stability, various forms

of radiation, radioactive decay, and the interaction of radiation with matter. Emphasis is placed on neutron reactions in various core and structural materials, neutron cross sections, and the development and analysis of the neutron balance equation applied to various reactor types. Key aspects of nuclear reactor core physics and shielding design are treated. Prerequisite: junior standing. (3)

10.332 Introduction to Nuclear Engineering II (same as 24.332)

A continuation of 10.331 with focus on heat removal and energy conversion in pressurized and boiling water reactors. Heat transfer in fuel elements and shields and the thermal and flow characteristics of boiling and non-boiling liquids. First and Second Law analysis of power plant systems and components. Engineered safety and overall reactor core and plant design considerations. Prerequisite: 10.331. (3)

10.402 Engineering Analysis of Coating and Converting Systems

Lectures and problems concerned with the engineering design, technology and economics of paper and paperboard processes. Rheology and engineering properties of coating materials. Mechanical processes, coating, impregnating, laminating, printing processes, ceramic glazes and porcelain enamels are discussed in detail. Prerequisite: permission of instructor. (4)

10.403 Kinetics and Reactor Design

Review of principles underlying rates of transformation of matter and energy; effect of temperature and catalysis on chemical reactions. Introduction to the basic ideas underlying chemical reaction engineering. May be taken for graduate credit. Prerequisites: 10.311, 84.345. (3)

10.405 Design of Paper

Fundamentals of the mechanical and optical testing of paper and allied products. Discussion of engineering mechanics involved in various testing procedures. Statistical analysis of test data. Structure of materials revealed by physical tests. Laboratory projects designed to illustrate problems in development of paper products and associated required processes. Prerequisite: permission of instructor. (3)

10.409 Economics and Process Analysis

Economic evaluation of manufacturing operations and projects. Accounting terms, time value of money, evaluation of investment alternatives. A major part of the required work involves the development of written plans for establishing specific enterprises. Oral presentations of findings are required. Prerequisites: 10.206, 10.217, 10.305, 10.310. (3)

10.410 Chemical Plant Design

This course is the logical continuation of 10.409. The principles of technical and economic evaluation are applied to specific chemical engineering problems. A group of students is given a statement of the problem. They are required to find information on raw materials, products, thermodynamic parameters and plant practices in order to develop the assumptions required to carry out an examination of technical and economic feasibility. Each group generates a final report for each problem. Homework is also assigned to assist the student in the specifics of the problems. Prerequisite: 10.206, 10.217, 10.305, 10.310, 10.409. (3)

10.413 Process Dynamics and Control

An introduction to chemical process control. Description of processes and equipment by differential equations and the Laplace transform. Development of block diagrams. System stability is studied by both root locus and frequency response methods. May be taken for graduate credit. Prerequisites: 10.306, 10.217. (3)

10.416 Process Operations Laboratory

Experimental projects dealing with heat and mass transfer, separations and process control. Written and oral reports required. Prerequisites: 10.310, 10.413. (2)

10.419/20 Special Senior Projects

Original research projects primarily in the chemical engineering field and supervised by a staff member of the department. Written reports required. Prerequisite: permission of instructor. Credits arranged.

10.431 Nuclear Reactor Systems and Operations (same as 24.431)

Review of plant systems and operations. Familiarization with actual startup and operation of the UMass Lowell reactor. Detailed study, operation, and measurement of parameters in key systems,

including the reactor control and radiation monitoring systems, and the primary coolant transport, cleanup, and energy removal systems. Overview of regulatory concerns and technical specifications for siting and operation of nuclear facilities. (3)

10.432 Nuclear Systems Design and Analysis (same as 24.432)

A design course that focuses on the use of modern computer analysis tools for the design and analysis of nuclear systems. Reactor physics and shielding codes and thermal and transient analysis software are introduced and used as necessary for the particular design project under study. Detailed analyses are completed by small design teams with individual responsibility for a particular aspect of the design. Oral and written communication skills are emphasized. Prerequisite: senior standing. (3)

10.494/6 Selected Topics in Paper Engineering

Topics in paper engineering. Content may vary from year to year to reflect contemporary applications of paper engineering. Prerequisite: permission of instructor. (3)

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

10.501 Paper Industry Process Analysis

Processes of fiber separation from raw materials, fiber purification and mechanical processing of fiber and sheet formation. Chemical engineering theory is applied to the analysis of these operations. Prerequisite: permission of instructor. (3)

10.502 Principles of Chemical Engineering

Introduction to the field of chemical engineering and solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships. Non-majors only. (3)

10.504 Process Calculations of Paper and Pulp Processes

Application of chemical engineering principles to the processes employed in the pulp and paper industries. Process calculations are made and the techniques applied to the design of processes in these

areas. Prerequisite: permission of instructor. (3)

10.506 Colloid and Interfacial Science and Engineering

Unifying principles and the three main classes of colloids (dispersions, macromolecular solutions and micelles) are considered. Topics covered include surface tension, work and energy, effect of surface curvature, zeta potential, surface activity and diverse applications of interest to chemical engineers. Prerequisite: permission of instructor. (3)

10.509 System Dynamics (Same as 24.509)

Mathematical foundation using the state-variable approach. Topics include matrix methods, Laplace and Fourier transforms, transfer functions, frequency response and stability analyses, and distributed/lumped parameter systems. Applications to mechanical and thermo-fluid systems. Modeling and simulation of systems using Matlab are emphasized. A comprehensive project, including formal written and oral reports, is required. Prerequisite: permission of instructor. (3)

10.510 Advanced Separation Processes

This course emphasizes separation processes requiring a rate analysis for adequate understanding, which includes most of the newer separation methods of industrial importance such as membrane, sorption and chromatographic separations. Unifying fundamental relations and concepts are emphasized. Graphical and numerical design procedures are covered. Prerequisite: 10.310 or permission of instructor. (3)

10.518 Microprocessor Control

Single board computers and single chip controllers and how they are used in chemical process control. Programming methods for using minicomputers as process controllers; interfacing requirements and communications. Laboratory projects include both software and hardware. Prerequisite: permission of instructor. (4)

10.522 Computer-Aided Chemical Process Design

Process synthesis, definition, and characterization. Introduction to modular process simulation packages such as ASPEN PLUS. Recycle and tear stream

analysis. Stream convergence. Unit operation models. Flowsheet manipulation. Data records and physical property estimation techniques. Prerequisite: permission of instructor. (3)

10.523 Electronic Materials Processing

Materials processing methods in electronics and related industries; crystal contamination control, growth, diffusion, etching, epitaxy, ion implantation, lithography, and other topics. Prerequisite: permission of instructor. (3)

10.528 Advanced Transport Phenomena

An advanced study of the mechanisms of the transport processes. Transport equations are developed from both microscopic and macroscopic viewpoints. Analogies and similarities between the transport processes are discussed. Considerable emphasis is placed upon solutions to problems. Prerequisite: permission of instructor. (3)

10.530 Advanced Control Strategies

An introduction to computer control and to some of the common control strategies applied to the design of complex chemical process control systems. Prerequisite: 10.413 or equivalent. (3)

10.531 Survey of Ceramic Materials

Modern ceramics; ceramic materials processing, characterization and properties. Prerequisite: 10.308 or permission of instructor. (3)

10.532 Principles of Chemical Engineering II

Continuation of Principles of Chemical Engineering including real gas relationships, humidity, energy balances, and combined mass-energy balance systems. Non-majors only. Prerequisite: 10.502 or permission of instructor. (3)

10.533 Macromolecular Science and Engineering

This course emphasizes the relation of molecular and macroscopic properties and end-use to polymer synthesis and commercial manufacture. Pertinent fundamental principles are reviewed. Prerequisite: permission of instructor. (3)

10.534 Special Ceramic Projects

Original research projects in the ceramic engineering field and supervised by a staff member of the department. Written reports required. Prerequisite: permission of instructor.

10.535 Principles of Cell and Microbe Cultivation

This course presents the principles of biochemical engineering with an emphasis on the unit operation of cell cultivation for production of commercially important products, especially biopharmaceuticals. The bioreactor is viewed as a device for controlling the environment of recombinant and traditional cultures. Major topics include media design, kinetics of growth and production, expression systems, bioreactor types, cell physiology, and bioprocess economics. Prerequisite: permission of instructor. (3)

10.539 Mathematical Methods for Engineers (Same as 24.539)

Review of several important analytical and computational techniques from the field of applied engineering mathematics, with an emphasis on the development and application of mathematical tools for solving practical engineering problems. Topics may include linear algebra, matrix/vector calculus, ordinary and partial differential equations, numerical methods, calculus of variations, and optimization theory. Computer work is required. Prerequisite: permission of instructor. (3)

10.540 Adhesion and Adhesives

The course develops an understanding of the fundamental concepts, relations, techniques, and applications of adhesion and adhesives. Prerequisites: 10.506. (3)

10.545 Isolation and Purification of Biotech Products

Efficient isolation and purification of biological products, especially proteins, from complex natural mixtures. Design project requires students to assume the role of project manager in developing a production process for a protein. Prerequisite: permission of instructor. (3)

10.546 Statistical Process Design

Several different experimental designs and design strategies will be used in the development of industrial processes. The design theory developed will be tested by laboratory evaluation. Prerequisite: permission of instructor. (3)

10.551/2 Directed Studies

The student, through regular and frequent consultation with the instructor, undertakes independent study in a particular area of chemical engineering. (3)

10.555 Biopharmaceutical GMP and Licensing

This course examines the regulatory framework in which "drugs", "biologics" and "cellular therapies" are evaluated in the United States, including the laws, regulations and the state of industrial practice. Prerequisite: permission of instructor. (3)

10.586 Biotechnology Processing Projects Laboratory

Development of manufacturing processes for the products of biotechnology are followed through a series of process unit operations. Following the synthesis, purification and formulation of a specific enzyme throughout the course, students examine interactions between process steps and evaluate the impact of each on the total production process. As a final project, students assume the role of project team leader, developing a commercial-scale production process for the enzyme. Prerequisite: permission of instructor. (3)

10.601/2 Chemical Engineering Seminar

Required of all chemical engineering graduate students. (3)

10.603/4 Materials Engineering Seminar

Required of all materials engineering graduate students. (3)

10.651/2 Selected Topics in Chemical Engineering

Advanced topics in the various fields of chemical engineering. Content may vary from year to year to reflect contemporary applications of chemical engineering. Credits arranged.

10.653/4 Selected Topics in Materials Engineering

Advanced topics in materials engineering. Content may vary from year to year to reflect contemporary applications of materials engineering. Credits arranged.

10.701/2 Graduate Research in Chemical Engineering

Graduate students perform research work under the supervision of a senior chemical engineering staff member. The thesis or project must be approved by an examining committee appointed by the department head. (3)

10.743 Graduate Research in Chemical Engineering (3)

10.746 Graduate Research in Chemical Engineering (3)

10.751 Advanced Projects in Chemical Engineering

Special projects laboratory undertaken by a student to expand his/her knowledge in specific fields not necessarily related to his/her thesis. Content of project, hours assigned and supervisor must be approved by the department head. Credits arranged.

10.753 Advanced Projects in Chemical Engineering

Special projects laboratory undertaken by a student to expand his/her knowledge in specific fields not necessarily related to his/her thesis. Content of project, hours assigned and supervisor must be approved by the department head. (3)

Programs in Nuclear Engineering

Program Coordinator: Gilbert J. Brown

The nuclear programs in the department offer a series of courses and research opportunities that allow specialization in the field of nuclear engineering. At the undergraduate level the program supports a formal Nuclear Engineering Option for Chemical Engineering students and a Nuclear Science and Engineering Minor for other engineering and science students at the University. At the graduate level the program offers an M.S. degree in Energy Engineering with a nuclear option.

Graduates with focused training via the undergraduate Nuclear Engineering Option or Nuclear Science and Engineering Minor programs can help the nuclear industry face the technical challenges of the future in areas such as safe disposal of radioactive waste, continued safe operation of existing nuclear power plants, improved plant performance, design of new power plants, and other advanced industrial and medical applications of nuclear technology.

The Nuclear Engineering Option

The Nuclear Engineering Option consists of a sequence of four courses that are specifically designed to give specialized education useful for working in a variety of nuclear technologies. The course selection integrates the key nuclear-related sub-

jects usually taken as part of an undergraduate degree program in Nuclear Engineering. The courses in the Nuclear Engineering Option provide a well balanced mix of engineering science, nuclear theory, design experience, and hands-on laboratory projects that combine to give the student all the elements necessary to analyze, design, and safely utilize nuclear technology in a variety of areas. The four course sequence is designed to be taken during the student's junior and senior years (one course per semester), and these courses simultaneously satisfy the bulk of the technical electives, including the design component, required as part of the Chemical Engineering curriculum.

Required Courses for Nuclear Engineering Option

Introduction to Nuclear Engineering I

Introduction to Nuclear Engineering II

This two course sequence provides an overview of pertinent topics in basic nuclear physics, nuclear reactor physics and shielding, health physics concepts, heat generation and removal in a nuclear reactor, power conversion, and overall system integration and safety.

Nuclear Reactor Systems and Operations

This course involves a detailed study of the operation and integration of the various systems needed in any nuclear reactor facility. Hands-on training is provided in the UMass Lowell 1 MW research reactor, including actual operation of the reactor and familiarization with several support systems (water cleanup system, primary coolant system, heat exchangers, etc.).

The fourth course for the Nuclear Engineering Option can be selected from a wide variety of nuclear-related courses offered within the Chemical and Nuclear Engineering Department or within other programs at the University. This last course is chosen in consultation with the student's advisor and is based on the particular interests of the individual student. This gives some flexibility in focusing the student's education in one of several areas. Qualified seniors can also select the fourth course for the Nuclear Engineering Option from a variety of approved graduate courses.

Nuclear Science and Engineering Minor

The Nuclear Science and Engineering minor consists of 18 credits of required course work that follows either an engineering or science track. Three core courses, common to both tracks, form the basis of the nuclear focus. These three courses are identical with those required as part of the Nuclear Engineering Option in Chemical Engineering.

Core Courses (required for both tracks)

Introduction to Nuclear Engineering I (24.331)

Introduction to Nuclear Engineering II (24.332)

Nuclear Reactor Systems and Operations (24.431)

The remaining three courses for the minor will be taken from either a Science or an Engineering track with the approval of the Nuclear Engineering Program Coordinator.

Science Track (3 courses) Recommended Courses

Modern Physics (95.210) or Physics of Radiation and Nuclei (95.355)

Nuclear Instrumentation (96.306)

Radiation Safety and Control (95/96.401 and 95/96.402)

Radiation Chemistry and Radioisotope Techniques (95.441)

Environmental Radiation and Nuclear Site Criteria (95.422)

Nuclear Physics (95.461)

Engineering Track (3 courses)**Recommended Courses**

Engineering Materials (10.308, 14.310/311, or 22.295)

Fluid Mechanics (10.206, 14.301, 22.381, or 26.314)

Heat Transfer (10.305, 22.341, 22.342, or 26.348)

Thermodynamics (10.311, 22.242, or 26.247)

Transport Phenomena (10.306 or 22.441)

Electrical Power Systems (16.211 or equivalent, 16.355, or 16.473)

Nuclear Systems and Operations (24.432, 24.419/420, or 24.495/496)

The Nuclear Science and Engineering Minor is for science majors such as Physics, Health Physics, Chemistry or Mathematics; or engineering majors such as Chemical, Civil, Electrical or Mechanical. Any qualified student with interests in this area of specialization can be admitted into the minor.

Most technical disciplines already have a solid mathematics, science, and engineering foundation, and a few specialized courses in nuclear technology would open up additional avenues for employment and career growth. Most students in science and engineering can satisfy the requirements for the Nuclear Science and Engineering Minor with only three additional courses beyond the normal sequence for their major program of study. In addition, the core courses from the nuclear minor may also satisfy a portion of the technical electives required by the major program.

Research Facilities

Students in the Nuclear Engineering Option or Nuclear Science and Engineering Minor can participate in ongoing faculty and graduate research using a variety of modern research tools and facilities. Program faculty are involved with the UMass-Lowell Radiation Laboratory which includes a 1MW research reactor, a Co-60 irradiation facility, a 5MeV van de Graaf accelerator, and a variety of radiation counting laboratories. The Center for Advanced Materials also houses state-of-the-art analytical equipment for the micro-characterization of materials. In addition to a large array of networked computer facilities throughout the University, the Department also maintains a computer laboratory where students can work individually or in small teams to address a variety of homework and design projects, or perform advanced research. One of the major strengths of the UMass Lowell nuclear program lies in its emphasis in advanced computational techniques, with special focus towards the development and application of numerical methods for the analysis of nuclear systems.

Nuclear Engineering Program Scholarships

The Nuclear Engineering Program is fortunate to have strong industrial support from such sponsors as Boston Edison Company, Northeast Utilities, North Atlantic Energy Services Corporation (Seabrook), Stone and Webster, Yankee Atomic Electric Company and Duke Engineering and Services. A large portion of the funds from these companies is being used to support students.

Student scholarships, up to \$2500, are available on a competitive basis from the Institute for Nuclear Power Operations, Department of Energy and American Nuclear Society. Students are also eligible to apply for \$3500 need based scholarships through the American Nuclear Society and the UMass Lowell Hoff Scholarships which award up to full tuition for a maximum of six semesters. Several of our students have received these scholarships.

Summer industrial internships, cooperative education work experience opportunities, UMass Lowell Research Reactor summer internships and part time jobs are also available to qualified candidates.

Professional Development Activities Students have the opportunity to gain practical experience at operating nuclear reactors through course work and through part-time work at the UMass Lowell Research Reactor and through cooperative education and summer work at nuclear power reactors and nuclear engineering firms. Students can study to take the U.S. Nuclear Regulatory Commission License examination and become a federally licensed reactor operator at our reactor. Cooperative education appointments have been arranged for selected students who worked for a year at a power reactor and then returned to school to finish their degree. Summer internships are available to students through our Seabrook Station Internship Program and at other local companies involved in nuclear related operations and support.

Students interested in the nuclear field are encouraged to join the student chapter of the American Nuclear Society (ANS). This

entitles them to receive the journal Nuclear News and to attend regional and national meetings and to otherwise participate with other nuclear engineering students around the country. A local chapter of the Nuclear Engineering Honor Society, Alpha Nu Sigma, is open to qualified students.

Both faculty and students participate in the annual ANS Regional Student Conference. UMass Lowell students attend and typically present papers based on their research, in competition with their peers at other schools. In recent years, the University has taken several awards for "best paper" in a session. There is financial support for students to participate in these professional development activities.

Nuclear Engineering (Course Prefix: 24)

24.331 Introduction to Nuclear Engineering I (same as 10.331)

Review of relevant nuclear physics topics including nuclear stability, various forms of radiation, radioactive decay, and the interaction of radiation with matter including health effects. Emphasis is placed on neutron reactions in various core and structural materials, neutron cross sections, and the development and analysis of the neutron balance equation applied to various reactor types. Key aspects of nuclear reactor core physics and shielding design are treated. Prerequisite: junior standing. (3)

24.332 Introduction to Nuclear Engineering II (same as 10.332)

A continuation of 24.331 with additional focus on heat removal and energy conversion in pressurized and boiling water reactors. Heat transfer in fuel elements and shields and the thermal and flow characteristics of boiling and non-boiling liquids. First and Second Law analysis of power plant systems and components. Engineered safety and overall reactor core and plant design considerations. Prerequisite: 24.331. (3)

24.419 Reactor Operator Training I Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator License. Prerequisite: permission of instructor. (3)

24.420 Reactor Operator Training II
Continuation of 24.419. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test. Prerequisite: permission of instructor. (3)

24.431 Nuclear Reactor Systems and Operations (same as 10.431)

Review of plant systems and operations. Familiarization with actual startup and operation of the UMass Lowell reactor. Detailed study, operation, and measurement of parameters in key systems, including the reactor control and radiation monitoring systems, and the primary coolant transport, cleanup, and energy removal systems. Overview of regulatory concerns and technical specifications for siting and operation of nuclear facilities. (3)

24.432 Nuclear Systems Design and Analysis (same as 10.432)

A design course that focuses on the use of modern computer analysis tools for the design and analysis of nuclear systems. Reactor physics and shielding codes and thermal and transient analysis software are introduced and used as necessary for the particular design project under study. Detailed analyses are completed by small design teams with individual responsibility for a particular aspect of the design. Oral and written communication skills are emphasized. Prerequisite: senior standing. (3)

24.495/6 Directed Studies

Special problems in nuclear science and engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of instructor. (3)

Primarily for Graduate Students
Graduate courses are open to undergraduates with permission of the instructor.

24.504 Energy Engineering Workshop
A group/individual design project. The design effort will integrate many aspects of the student's engineering background, including design concepts, technical analyses, economic and safety considerations, etc. A formal report and oral presentation are required. Prerequisite: permission of instructor. (3)

24.505 Reactor Physics

Advanced treatment of several topics in reactor physics, including cross sections and processing methods, development of transport theory, reduction to diffusion theory, and analyses of analytical and numerical solutions of the resultant balance equations. Prerequisite: permission of instructor. (3)

24.506 Special Topics in Reactor Physics

Potential topics include nodal methods, perturbation theory, data sensitivity and uncertainty analysis, fuel management and core optimization methods, noise analysis, space-time kinetics, reactor control, reactor safety, etc. May be repeated since topics vary. Prerequisite: permission of instructor. (3)

24.507 Reactor Engineering and Safety Analysis

Modeling and analysis of reactor thermal-hydraulics and safety systems. Topics include nuclear heat generation and transport, single and two-phase flow, boiling crisis, and safety analysis. Prerequisite: permission of instructor. (3)

24.509 System Dynamics

Mathematical foundation using the state-variable approach. Topics include matrix methods, Laplace and Fourier transforms, transfer functions, frequency response and stability analyses, and distributed/lumped parameter systems. Applications to mechanical and thermo-fluid systems. Modeling and simulation of systems using Matlab are emphasized. A comprehensive project, including formal written and oral reports, is required. Prerequisite: permission of instructor. (3)

24.519 Reactor Operator Training
Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator License. Prerequisite: permission of instructor. (3)

24.520 Reactor Operator Training
Continuation of 24.519. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test. Prerequisite: permission of instructor. (3)

24.522 Nuclear Materials

Review of metals and metal oxide properties. Radiation damage in fluids, plastics, ceramics, electronics, and graphite. Hardening, embrittlement, swelling, and creep in metals. Damage mechanisms. Shielding materials. Prerequisite: permission of instructor. (3)

24.531/2 Directed Studies

Special problems in nuclear science and engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of instructor. (3)

24.539 Mathematical Methods for Engineers (same as 10.539)

Review of several important analytical and computational techniques from the field of applied engineering mathematics, with an emphasis on the development and applications of mathematical tools for solving practical engineering problems. Topics may include linear algebra, matrix/vector calculus, ordinary and partial differential equations, numerical methods, calculus of variations, and optimization methods. Some computer work with Matlab will be required. Prerequisite: permission of instructor. (3)

24.541 X Ray Diffraction of Advanced Materials

Diffraction theory as a basis for understanding and for determining crystal structure of polycrystalline materials. Crystal defects such as dislocations, twins and point defects will be discussed. Physics and chemistry of advanced materials will be covered. Qualitative and quantitative elemental analyses of second phase or precipitates on submicron scale by energy dispersive x-ray spectroscopy. Prerequisite: permission of instructor. (3)

24.542 Microscopy of Advanced Materials

The principles and practical applications of analytical methods for examining ceramics, electronic materials, polymers, and biological materials are covered. Students learn the practical and theoretical use of analytical instruments such as the transmission electron microscope, scanning electron microscope, secondary ion mass spectroscopy, electron spectroscopy chemical analysis for materials research and for problem solving in materials science. Prerequisite: permission of

instructor. (3)

24.543 Applied Nuclear Materials Research

Topographical and chemical features of bulk materials by scanning electron microscopy. High resolution images of surface structure of polymers and crystalline materials in three dimensions by scanning tunneling microscope and atomic force microscope. Surface chemistry by SIMS and ESCA. Applications: nanocrystalline features in amorphous materials, submicron morphological and device features, distribution and structure of interfaces and grain boundaries. Prerequisite: permission of instructor. (3)

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Department of Civil and Environmental Engineering

William B. Moeller, Chairperson

Professors: Clifford J. Bruell, Nathan H. Gartner, Hilary I. Inyang, Donald G. Leitch, William B. Moeller, Samuel G. Paikowsky, Burton A. Segall, John M. Ting

Associate Professors: Susan Faraji, Chronis Stamatiadis

Assistant Professors: Pradeep Kurup

Civil Engineers plan, design, build, manage and rehabilitate the facilities essential to modern society: homes and work places; transportation systems for commerce and recreation, and water treatment and waste disposal systems for a healthful life. As part of the Construction Industry, they build bridges, buildings, tunnels, dams, canals, irrigation systems, harbors, highways, airports, water supply systems, and waste disposal facilities. They develop solutions to environmental problems, study new methods to control traffic, and design outer space and under sea structures.

Civil and Environmental Engineering Practice encompasses a wide range of specialties, including construction management, engineering mechanics, environmental engineering, geotechnical engineering, hydraulics, intelligent transportation systems, irrigation and drainage, materials engineering, structural engineering, surveying and site engineering, urban planning and development, urban transportation, water and wastewater treatment system design, water resources planning and management, hazardous waste site remediation, and waterway, port, coastal and ocean engineering.

Civil engineers work in both the public and private sector. They serve as city, town and state public works and environmental engineers. They own and are

employed by consulting firms, construction companies and industries. They are employed by a variety of federal and state agencies such as, the Corps of Engineers, the Department of Transportation, the Environmental Protection Agency, the Federal Aviation Administration, Massachusetts Water Resources Authority and the Massachusetts Highway Department.

Program Objectives

The program objective of the Department of Civil and Environmental Engineering is to provide its students with a well balanced, high quality education in four areas of civil engineering: environmental, geotechnical, structural, and transportation engineering that will permit them to practice civil engineering at a professional level, that will prepare them for graduate study, that will promote life long learning and continuing professional development and that will provide them with the skills and knowledge necessary to develop into active contributors to the economic and social vitality of the region.

Undergraduate Program

The first year of undergraduate study is devoted to developing writing skills and proficiency in the areas of mathematics and science that serve as a foundation for upper level professional studies. During the second year of study, students learn the principles of engineering mechanics, strength of materials, and surveying. Junior and senior year course work gives students a working knowledge of structural, environmental, geotechnical, and transportation engineering. In addition to education in these four basic areas of civil engineering practice, advanced elective courses are available in each area during the senior year. Engineering design concepts and computer aided engineering are integrated throughout the program.

Course of Study for Civil and Environmental Engineering

Freshman Year

Fall Semester

25.107	Intro to Engineering I	2
42.101	College Writing I	3

84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
95.141	Physics I	3
96.141	Fund of Exp Physics I	1
		17

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.132	Calculus II	4+
—	(Gen Ed)Hist Studies	3
		16

Sophomore Year

Fall Semester

14.203	Statics	3
14.225	Surveying I & Lab	3
92.231	Calculus III	4
14.286	Prob & Stats for Eng*	3
—	(Gen Ed)Beh & Soc Sci	3
		16

Spring Semester

14.204	Strength of Materials	3
14.205	Dynamics	3
14.226	Geomatics	3
92.236	Eng Diff Equations*	3
—	(Gen Ed)Literature3	
		15

Junior Year

Fall Semester

14.301	Fluid Mechanics	3
14.310	Eng. Materials	3
14.311	Eng. Materials Lab 1	
14.350	Structural Analysis I	3
14.372	Civil Engg. Systems	3
49.201	(Gen Ed-BS)Economics I	3
		16

Spring Semester

14.330	Soil Mechanics	3
14.332	Soil Mechanics Lab	1
14.333	Fluid Mechanics Lab	1
14.340	Transportation Eng.	3
14.341	Transportation Eng Lab1	
14.352	Reinf Concrete Design	3
14.362	Environmental Eng I	3
		15

Senior Year**Fall Semester**

14.431	Foundation & Soil Eng	3
14.452	Steel Design	3
14.460	Water Res Eng.	3
	Professional Elective	3
10.347	Elem Therm & Heat Tr*3++	
—	(Gen Ed)Aesthetics	3

18

Spring Semester

14.470	Civil Eng. Economics	3
14.485	Capstone Design	3
	Professional Elective	3
16.213	Fund of Electricity	3++
—	(Gen Ed)Values**	3

15

Total Credits: 128

* or equivalent

** 45.334 Engineering and Ethics is recommended

+ Calculus II is a prerequisite for many sophomore courses; students enrolled in other Calculus courses may need to take Calculus II in the summer to complete this program in four years.

++ May be taken anytime after sophomore year.

The Five Year BS/MS Civil Engineering Program

The purpose of this program is to offer qualified undergraduate students an accelerated program of study leading to a Master of Science in Civil and Environmental Engineering at the end of five years of study. Students benefit from the efficiency of a continuous, coordinated sequence of subjects which allows for reduced credit hour requirements. Students can receive the B.S. in Engineering at the end of the fourth year and the M.S. in Engineering at the end of the fifth year if all requirements are met.

General Requirements

Application to the five year program is made during the second semester of the junior year. A minimum grade point average of 3.0 based upon the first five semesters of grades, is required for admission into the program.

Applicants who satisfy the Graduate

School and departmental admission requirements for the five-year program will be assigned to a graduate faculty member who will act as their program advisor. The M.S.C.E. degree requires the successful completion of a minimum of 30 credit hours. These 30 hours include at least 24 hours in class and seminar study, of which at least 18 hours must be at the 500 level or higher. Courses at the 400 level are designed for seniors, but may be taken by graduate students for graduate credit if written approval is given by the student's advisor.

Special Requirements

A student seeking a five year M.S.C.E. must choose an area of specialized study. These areas include: environmental, geotechnical, geoenvironmental, structural, and transportation engineering. Programs of study in each of these areas are described in the Graduate Catalog.

Civil and Environmental Engineering (Course Prefix: 14)**14.203 Statics**

Vector concepts of forces and moments of forces. Static equilibrium of particles, rigid bodies and simple structures. Static friction forces, geometric properties of sections. Prerequisites: 92.132 and 95.141. I(3,0)3

14.204 Strength of Materials

Stress and strain, stress transformation, temperature stresses. Stress and deformation in bodies under axial, shearing, flexural, torsional and combined loadings. Shear and bending moment diagrams. Euler Columns. Prerequisite: 14.203. II(3,0)3

14.205 Dynamics

Vector development of kinematics of particles and rigid bodies with respect to fixed and moving coordinate systems of one, two, and three dimensions. The dynamics of particles, systems of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum methods. Prerequisites: 14.203 and 92.231. I(3,0)3

14.225 Surveying

A presentation of the basic instruments used in survey processes including distance, angle and level measurements. Analysis and adjustment of random errors. Principles of closed and open traverses. Fieldwork practice in instrument use and office-type projects in contour mapping and the application of contoured topography to highway and water-control projects. Prerequisites: 25.107, 25.108 and 92.131 or 92.125. I(2,3)3

14.226 Geomatics

Principles and practice of route surveys and designs. Topics include simple and compound circular curves, intersections of straight and curved baselines, vertical alignment principles including parabolic easement curves, earthwork operations and determination of volumes. Includes office-type projects illustrative of the application of surveying information to Civil Engineering projects such as water resources, sanitary sewers and property subdivision. Fieldwork instruction in basic traverse surveys, gathering of topographic information, and the staking-out of buildings and circular curves.

Prerequisite: 14.225. II(2,3)3

14.286 Probability & Statistics for Engineering

Probability, statistics, reliability and decision with applications in engineering. Probability of events, discrete and continuous random variables, probability density functions and distributions, estimation, regression and correlation techniques, risk and reliability. Prerequisites: 92.132. I(3,0)3

14.301 Fluid Mechanics

Fluid properties, fluid statics, fluid dynamics including continuity, impulse-momentum and energy equations. Pipe flow, turbomachinery, similitude and modeling, laminar and turbulent flow, boundary layer and closed conduct design. Prerequisites: 14.205, 92.234. (3,0)3

14.310 Engineering Materials

A treatment of the properties of engineering materials which influence the design, construction and maintenance of Civil Engineering works. Included are such materials as ferrous and non-ferrous metals, timber, asphalt, and cementitious materials. Supplemented by laboratory testing of various engineering materials. Prerequisites: 84.122, 14.204. I(3,0)3

14.311 Engineering Materials**Laboratory**

Experiments and written reports. Testing and measurement techniques and material standards illustrating behavior of materials, including metals, wood, and Portland cement concrete. I(0,3)1

14.330 Soil Mechanics

Development of the fundamental principles of soil mechanics as utilized in soil and foundation engineering. Topics include: classification, index properties, strength and stress-strain behavior, effective stress principle, permeability, flow and consolidation. Introduction to basic soil mechanics laboratory practice. Prerequisites: 14.204, 14.301, 14.310. II(3,0)3

14.332 Fluid Mechanics Laboratory

Laboratory experiments that illustrate fluid flow theory. Course emphasizes data acquisition and analysis, and engineering report writing. Prerequisites: 14.301. II(1,3)1

14.333 Soil Mechanics Laboratory

Laboratory experience that illustrates soil mechanics and fluid flow theory. Experiments are conducted in the soils and hydraulics laboratories. Course emphasizes data acquisition and analysis and writing engineering reports. Prerequisites: 14.301. Corequisite: 14.330. II(1,3)1

14.340 Transportation Engineering

Development of the basic principles pertaining to the movement of people and goods by modern transportation systems. Techno-economic characteristics of the various transportation modes. Aspects of planning, design and operation of land, air and water transportation facilities. Development, structure and function of the U.S. transportation system. Corequisite: 14.226, 14.341 II(3,0)

14.341 Transportation Engineering Laboratory

Development of basic principles pertaining to the movement of people and goods by modern transportation systems. Aspects of planning, design and operation of transportation facilities with primary emphasis on highway systems. Corequisite: 14.340 II(0,3)I

14.350 Structural Analysis

Principles of structural analysis applied to typical civil engineering structures as the

initial step in the total design concept. Emphasis on the classical methods of analysis of statically determinate and indeterminate structures. The personal computer as an analytical tool. Prerequisite: 14.204. I(3,0)3

14.352 Reinforced Concrete Design

Ultimate strength and elastic behavior of reinforced concrete structural members, continuity in building frames, deflections, shear reinforcement, development length and bar cutoffs, columns and footings. Prerequisites: 14.310, 14.350. II(3,0)3

14.362 Environmental Engineering I

Physical, chemical and biological principles of the treatment of water and sewage are considered along with their application to treatment systems. The several system components of water and sewage treatment plants are studied to provide a basis for design capability. Prerequisite: junior status. II(3,0)3

14.372 Civil Engineering Systems Analysis

Introduction to methods of operations research, management science and economic analysis used in the design, planning and managing of engineering systems. Main topics covered: systems modeling, optimization concepts, network analysis, mathematical programming, critical path analysis, decision analysis, economic consideration. Prerequisite: junior status. I(3,0)3

14.431 Foundation and Soil Engineering

The application of soil mechanics to the design and analysis of foundations and soil structures. Topics include: subsurface exploration, analysis and design of shallow and deep foundations, earth pressures, retaining structures, and slope stability. Prerequisite: 14.330. I(3,0)3

14.452 Steel Design

An introduction to structural steel design with emphasis on use and interpretation of the AISC Manual and LRFD Specifications. Subjects include design of tension, compression, beams, and beam-column members, plus bolted and welded connections. Other topics may include composite beams, plate girders, building connections and plastic analysis and design. Prerequisite: 14.350. I(3,0)3

14.460 Water Resources Engineering

Elements of classical hydrology including

precipitation, runoff, abstractions, ground-water, hydrographs, statistics in hydrology; open channel flow and water law. Prerequisite: 14.301. I(3,0)3

14.463 Environmental Engineering II

A study of the effects of waste discharges on the aquatic environment. Streams, lakes and marine systems are considered. Modeling of effects are explored through use of the Streeter-Phelps equation and various modifications. Stream sampling techniques, data collection and analysis are stressed. Prerequisite: 14.362. II(3,0)3

14.470 Civil Engineering Economics

Presentation of mathematical principles of economic analysis, with emphasis on defining alternatives and predicting consequences of proposed investments. Attention is placed on the economic, social and environmental impacts of proposed Civil Engineering projects. The attractiveness of investments are judged by rate of return, equivalent cash flow and benefit cost ratio techniques. Sensitivity analysis and depreciation in economic studies are also discussed. Prerequisite: 49.201. II(3,0)3

14.475 Construction Management

Development of management skills and techniques to plan, schedule, supervise, and control construction projects. Project estimating; labor costs and productivity; construction plans, specifications and contracts; labor relations; time, cost and quality control; construction equipment and project decision making and financing. Prerequisite: senior status. I(3,0)3

14.480 to 14.483 Special Topics in Civil Engineering

Contemporary topics in selected areas of study within civil engineering. Course content is chosen by the instructor to meet the interests of the students. Prerequisite: senior status. I,II(3,0)3

14.485 Capstone Design

Integration of curriculum by comprehensive design exercise to professional standards. Team effort, reports, presentations, open-ended problems of analysis and design. Prerequisites: 14.340, 14.352, 14.431, 14.452, 14.460. II(1,6)3

Elective Graduate Courses

The graduate courses listed below may be used as civil engineering electives with permission of the instructor and the graduate academic advisor. These courses are

designed for Civil Engineering graduate students in Environmental, Geotechnical, Geoenvironmental, Structural and Transportation programs, but can also be selected as undergraduate elective offerings.

14.504 Advanced Strength of Materials

Stress and strain at a point; curved beam theory, unsymmetrical bending, shear center, torsion of non-circular sections; theories of failure; selected topics in solid mechanics. (3,0)3

14.505 Construction Occupational Safety and Health

A seminar covering various topics in construction occupational health and safety. Topics to be covered include: OSHA and Regulation, Fatalities, Fall Protection and Rigging, Confined Spaces and Trenches, Electrical and Hand Tool Safety (Lockout/Tagout), Job Hazard Analysis, Noise, Ergonomics and the Prevention of Musculoskeletal Disorders, Industrial Hygiene and Exposure to Asbestos, PNOC, Diesel and Lead, and Construction Safety Culture. Outside speakers (many will be safety representatives from construction contractors or other professionals in the construction industry) will be brought in to discuss these topics. II(3,0)3

14.529 Engineering with Geosynthetics

Rigorous treatment in the mechanism and behavior of reinforced soil materials. Laboratory and in-situ tests for determining the engineering properties of geosynthetics (geotextiles, geomembranes, geogrids and geocomposites). Design principles and examples of geosynthetics for separation, soil reinforcement and stabilization, filtration and drainage. Prerequisite: 14.431 or 14.531. (3,0)3

14.531 Advanced Soil Mechanics
Theories of soil mechanics and their application. Drained and undrained stress-strain and strength behavior of soils. Lateral earth pressures, bearing capacity, slope stability, seepage and consolidation. Lab and insitu testing. Prerequisite: 14.330 or equivalent. (3,0)3

14.533 Advanced Foundation Engineering

Design and analysis of shallow foundations, excavations and retaining structures including: site exploration, bearing capaci-

ty and settlement theories, earth pressures, braced and unbraced excavations, rigid and flexible retaining structures, reinforced earth, dewatering methods and monitoring techniques. Prerequisite: 14.431 or 14.531. (3,0)3

14.536 Soil Engineering

The study of soil as an engineering material, and its use in earth dams, road embankments, flow control, and compacted fills. Stability of natural slopes, soil reinforcement and stabilization. Prerequisite: 14.531. (3,0)3

14.537 Experimental Soil Mechanics

Application of testing procedures to the evaluation of soil type and engineering properties. Testing for classification, permeability, consolidation, direct and triaxial shear and field parameters. The technical procedures are followed by data analysis, evaluation and presentation. Critical examination of standard testing procedures, evaluation of engineering parameters, error estimation and research devices. Prerequisite: 14.531.

14.539 Ground Improvement

Design and construction methods for strengthening the properties and behavior of soils. Highway embankments, soil nailing, soil grouting, landslide investigation and mitigation, dynamic compaction, stone columns. Prerequisites: 14.330 or 14.531. (3,0)3

14.540 Urban Transportation Planning

Basic principles of urban transportation planning. Characteristics of urban travel; characteristics of urban transportation systems. Data collection; analysis of travel demand; analysis of system performance. Project evaluation; project implementations. (3,0)3

14.541 Traffic Engineering

Safe and efficient movement of goods and people on streets and highways, including aspects of (a) transportation planning; (b) geometric design of street and highway facilities; (c) traffic operations and control; (d) traffic safety; and; (e) management and maintenance of transportation facilities. Topics include: traffic stream characteristics; traffic engineering studies; capacity analysis; optimization of signal timings; simulation of traffic operations; accident studies; parking studies; environmental impacts. Prerequisite: 14.340. II(3,0)3

14.543 Transportation Systems Analysis

Demand, supply and equilibrium in multimodal transportation systems. Analysis of transportation decisions; searching for optimal design strategies. (3,0)3

14.545 Public Transit

Planning and design of public transportation systems and their technical, operational and cost characteristics. Discussion of the impact of public transportation on urban development; the different transit modes, including regional and rapid rail transit (RRT), light rail transit (LRT), buses, and paratransit, and their relative role in urban transportation; planning, design, operation and performance of transit systems (service frequency and headways, speed, capacity, productivity, utilization); routes and networks; scheduling; terminal layout; innovative transit technologies and their feasibility. Prerequisites: 14.340. 14.540 while not required will be an advantage. Instructor's approval is required. I(3,0)3

14.547 Planning and Design of Airports

Planning and design of civil airports. Estimation of air travel demand. Aircraft characteristics related to design; payload, range, runway requirements. Analysis of wind data, runway orientation and obstruction free requirements. Airport configuration, aircraft operations, and capacity of airfield elements. Design of the terminal system, ground access system, and parking facilities. Prerequisite: 14.340. I(3,0)3

14.549 Traffic Flow Theory

Examination of the fundamental traffic flow characteristics - time headway, flow, time-space trajectories, speed, distance headway and density. In depth treatment of related analytical techniques including traffic stream modeling at both microscopic and macroscopic levels, supply and demand analysis, shock wave analysis, queuing analysis and simulation modeling of traffic systems. Prerequisites: 14.340. 14.541 and 14.522 while not required will be an advantage. Instructor's approval is required. II(3,0)3

14.550 Advanced Structural Analysis
Classical and matrix methods of structural analysis applied to complex plane trusses. Elementary space truss analysis. Elementary model analysis through the

use of influence lines for indeterminate structures. The digital computer and problem oriented languages as analytical tools. Prerequisite: 14.350. II(3,0)3

14.551 Design of Steel Structures
Elastic and plastic design of structural steel systems, residual stresses, local buckling, beam-columns, torsion and biaxial bending, composite steel-concrete members, load and resistance factor design. (3,0)3

14.552 Behavior of Reinforced Concrete Structures
Review of behavior and strength design methods for flexure and shear, anchorage, torsion, deep beams, slender columns and beam-columns, deflections, slabs and walls. (3,0)3

14.553 Wood Structures
Review of properties of wood, lumber, glued laminated timber and structural-use panels. Review of design loads and their distribution in wood-frame buildings. Design of wood members in tension, compression and bending; and design of connections. (3,0)3

14.556 Finite Element Analysis
Direct and variational methods are used to derive equations for structural elements. Static and dynamic problems are analyzed. (3,0)3

14.561 Physical Chemical Treatment Processes
Theories of physical chemical treatment processes and the laboratory (or pilot plant) techniques necessary to obtain design. Treatment processes for natural waters, domestic wastes, and industrial wastes. (3,0)3

14.562 Physical and Chemical Hydrogeology
Well hydraulics for the analysis of groundwater movement. A review of the processes of diffusion, dispersion, sorption, and retardation as related to the fate and transport of organic contaminants in groundwater systems. Factors influencing multi-dimensional contaminant plume formation and migration are addressed. (3,0)3

14.564 Computer Hydraulics and Hydrology
Advanced course in civil engineering hydraulics and hydrology. Development of skills and familiarization with pressure

conduit and open channel hydraulic models and Corps of Engineer and Soil Conservation Services, hydrologic programs. (3,0)3

14.567 Environmental Chemistry I
The chemistry of natural and polluted waters and the applied chemistry of water and wastewater treatment. Dilute aqueous solution chemistry of acid-base reactions and complex formation. Emphasizes chemical equilibrium and serves as a foundation for environmental studies. (3,0)3

14.568 Environmental Chemistry II
Environmental transport of organic chemicals and atmospheric gases in air, water and soil systems. The kinetics of mass transfer from an equilibrium perspective across environmental interfaces. (3,0)3

14.570 Small and Alternative Waste Water Treatment
A design oriented course covering subsurface disposal, surface systems disposal, nonconventional collection systems and planning approaches. (3,0)3

14.571 Surface Water Quality Modeling
Theory and application of surface water quality modeling will be combined interactively throughout the course. Data from a stream will be utilized in order to bring a public domain model into operation. (3,0)3

14.573 Municipal, Industrial and Hazardous Waste Management
Characterization, handling and disposal of municipal, industrial and hazardous wastes. Technologies such as landfills, recycling, incineration and composting are examined. (3,0)3

14.595 Hazardous Waste Site Remediation
Principles of hazardous waste site remediation using physical, chemical and biological remediation technologies. Technologies include: bioremediation, soil vapor extraction, in situ air sparging and vacuum enhanced recovery.

18.501 Wetland Ecology

18.502 Limnology

18.503 Toxicology and Risk Assessment

18.504 GIS for Environmental Science

18.523 Air Resources Management

18.527 Environmental Laws

The large body of law which has developed since the early 1960's is examined in considerable detail. Federal law relating to the environment, particularly with the Environmental Protection Agency and the Occupational Safety and Health Acts. State and local laws and ordinances are discussed where pertinent. (3,0)3

18.568 Environmental Chemistry Laboratory

Wet chemistry and instrumental techniques for the analysis of waters and wastewaters. Instrumental methods include atomic absorption spectroscopy, gas chromatography and potentiometric methods. (2,3)3

18.571 Air Pollution Phenomenology

Air pollutants: sources, emission rates, ambient concentrations, dispersion and transport. Photo-oxidant pollutants, particulate matter, acid deposition and global air pollution. (3,0)3

18.572 Energy and the Environment
Flow of energy in our present industrial society from extraction through transport and conversion to end use. Electricity: generation from fossil fuel, nuclear, hydro, solar and other sources. Environmental effects from all sources of energy on a local, regional and global scale. (3,0)3

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Assistant Professors: Kavitha Chandra

The electrical engineering curriculum provides a thorough grounding in electrical science and engineering, together with an intensive training in mathematics, and emphasizes the techniques of experimental science and technology through investigative laboratory work and class-room lecture-demonstrations. The Electrical Engineering Department strives to be a Department of choice for both local and regional students. We have responded to our ties to industry by offering focused programs both at the undergraduate and graduate level to provide a thinking and technically literate engineer of immediate value to the community. Our graduates are knowledgeable and practical problem solvers, most of whom remain to work in the State.

Our specific program outcomes can be summarized as follows. Graduating students will be able to demonstrate:

- i) an ability to formulate and solve engineering problems both theoretically and numerically
- ii) an ability to use test equipment and trouble shoot
- iii) an ability to design reliable systems or devices from initial specifications to a deliverable
- iv) an ability to clearly and coherently

describe verbally and in writing a technical project

v) an ability to appreciate the complexities of real world environments, including taking responsibility for oneself, for working with others and for being mindful of ethical, economic and contemporary concerns

vi) a competence in taking the initiative for their future professional development

The Department has 25 faculty, and many technology focus areas that reflect both our strengths. These are Micro- and Optoelectronic Materials, Circuits and Systems, Digital Technology and Computer Engineering, Electromagnetics and Electromagnetic Properties of Materials, Telecommunications and Information Engineering, Electrical Power and Energy Engineering.

The curriculum includes engineering science and design courses that provide a balanced view of hardware, software, application trade-offs. It includes the following student experiences: requirements analysis and specification, evaluation and testing, hardware-software integration, use of computer aided design tools and documentation. Such experiences are integrated throughout the curriculum and designed to encourage each student to engage in a major and meaningful design experience. An important aspect of the electrical engineering curriculum are the technical electives and the capstone project program of the senior year. Technical electives provide opportunities for broadening or deepening technical knowledge in a flexible manner and in accordance with student interests and competencies. The capstone project is organized to bring together knowledge from several courses toward solving a real-world engineering problem. The ECE Department has also linked with many local companies, both large and small, in order to offer Co-op opportunities for which course credit can be earned.

New tracks with a focus in computing skills as well as double majors in EE and Computer Science and EE and Physics are also offered.

The three tracks provide cohesive and coherent programs:

EE Track: a thorough grounding in the fundamentals of electrical engineering that would allow a graduate to function effectively in industry or continue on to graduate school.

Computing Foundation Track: a program which allows ECE students to take the same courses in the first two years that a CS major would be exposed to. These fundamental CS courses provide a thorough grounding in CS for those students who want it. A choice for these students is to revert to a specialization in EE, continue with CS courses in the Computing Concentration Track, or move into CS if they wish.

Computing Concentration Track: a program which has a somewhat reduced EE content to allow additional CS courses to be taken throughout the junior and senior years. The concentration remains a BSEE degree but with the addition of three more CS courses, students can take a double major.

A significant portion of the curriculum is also devoted to studies in the humanities and social sciences and considerable choice of subjects is allowed. These subjects broaden the student's outlook and serve to focus attention on the importance of nontechnical knowledge in determining the student's ultimate level of responsibility in professional life.

Students seeking admission into our program should be familiar with the admission and retention requirements of the College of Engineering. This curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET). All undergraduate students are assigned a faculty advisor and students are encouraged to meet with their advisor during each semester, especially during registration periods or whenever there is some matter of concern.

Course of Study for Electrical Engineering

Freshman Year

Fall Semester

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
25.110	Dean's Seminar	0
42.101	College Writing I	3
92.131	Calculus I	4
95.141	Physics I	3
96.141	Physics I Lab	1
		14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
42.102	College Writing II	3
92.132	Calculus II	4
95.144	Physics II	3
96.144	Physics II Lab	1
		14

Sophomore Year

Fall Semester

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2
16.216	Digital Control Prg.	3
92.231	Calculus III	4
—	General Ed Course	3
		15

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
16.217	Microprocomp Oper & Prog	3
16.265	Intro to Logic Design	3
92.236	Eng. Differential Equations	3
—	General Ed Course	3
		17

Junior Year

Fall Semester

16.364	Eng. Math	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.365	Electronics I	3

16.333	Materials Chemistry	3
45.334	Engineering Values	3
		17

Spring Semester

16.312	Electronics II Lab	2
16.355	Electromechanics	3
16.360	Engg Electromagnetic I	3
16.363	Signals & Sys II	3
16.366	Electronics II	3
		14

Senior Year

Fall Semester

16.399	Capstone Prop & Comm Skls3	
16.—	Technical Elective	3
16.—	Technical Elective	3
16.461	Engg Electromagnetics II	3
—	General Ed Course	3
		15

Spring Semester

16.413	Lin Feedbk Sys/Discr Sys	3
16.499	Capstone project	3
16.—	Technical Elective	3
—	General Ed Course	3
—	General Ed Course	3
		15

Total credits: 121

Technical Electives should contribute to total number of Engineering Topics credits required.

Computing Foundation

Freshman Year

Fall Semester

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
25.110	Dean's Seminar	0
42.101	College Writing I	3
91.101	Computing I	4
92.131	Calculus I	4
		14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
42.102	College Writing II	3
91.102	Computing II	4
92.132	Calculus II	4
—	Gen Ed Course	3
		17

Sophomore Year**Fall Semester**

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2
91.201	Computing III	4
92.231	Calculus III	4
95.141	Physics I	3
96.141	Physics I Lab	1
		17

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
92.236	Eng. Differential Equations	3
92.321	Discrete Structures	3
95.144	Physics II	3
96.144	Physics II Lab	1
		15

Junior Year**Fall Semester**

16.265	Intro to Logic Design	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.364	Eng. Math	3
16.365	Electronics I	3
16.333	Materials Chemistry	3
		17

Spring Semester

16.217	Microcomputer Op & Prog	3
16.312	Electronics II Lab	2
16.363	Signals & Systems II OR	3
92.386	Stats for Sci & Engg	
16.366	Electronics II	3
—	General Ed Course	3
		14

Senior Year**Fall Semester**

16.360	Electromagnetics I	3
16.399	Capstone Prop & Comm Skls	3
16.4—	Technical Elective	3
45.334	Engineering Values	3
—	General Ed Course	3
		15

Spring Semester

16.499	Capstone project	3
16.—	Technical Elective	3
16.—	Technical Elective	3
—	General Ed Course	3
—	General Ed Course	3
		15

Total minimum credits: 124

Technical Electives should contribute to total number of Engineering Topics credits required.

Computing Concentration**Freshman Year****Fall Semester**

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
25.110	Dean's Seminar	0
42.101	College Writing I	3
91.101	Computing I	4
92.131	Calculus I	4
		14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
42.102	College Writing II	3
91.102	Computing II	4
92.132	Calculus II	4
—	Gen Ed Course	3
		17

Sophomore Year**Fall Semester**

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2

91.201	Computing III	4
92.231	Calculus III	4
95.141	Physics I	3
96.141	Physics I Lab	1
		17

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
16.217	Microcomputer Op & Prog	3
92.236	Eng. Differential Equations	3
92.321	Discrete Structures	3
95.144	Physics II	3
96.144	Physics II Lab	1
		18

Junior Year**Fall Semester**

16.265	Intro to Logic Design	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.365	Electronics I	3
91.305	Computer Architecture	3
		14

Spring Semester

16.312	Electronics II Lab	2
16.363	Signals & Systems II OR	3
92.386	Stats for Sci & Engg	
16.366	Electronics II	3
91.308	Operating Systems	3
—	General Ed Course	3
		14

Senior Year**Fall Semester**

16.360	Electromagnetics I	3
16.399	Capstone Prop & Comm Skls	3
16.333	Materials Chemistry	3
45.334	Engineering Values	3
—	General Ed Course	3
		15

Spring Semester

16.499	Capstone project	3
91.304	Found of Comp Sci	3
91.404	Analysis of Algorithms	3

—	General Ed Course	3
—	General Ed Course	3
		15

Total minimum credits = 124

Technical Electives should contribute to total number of Engineering Topics credits required.

Computer Engineering Concentration

Beginning with the Fall semester 1994, the Electrical & Computer Engineering Department established a concentration in Computer Engineering for undergraduate students anticipating employment with companies that specialize in digital system design and production. The courses offered under this concentration address skills which will be attractive to prospective employers. These courses also provide a basis for continuing education leading to a Master's degree in Computer Engineering.

Prerequisites: satisfactory completion of an introductory course in logic design (16.265) and a course in microprocessors and assembly language (16.217).

Concentration requirements: a student meets the requirements for the computer engineering concentration by successfully completing any four of the following courses:

16.465	Logic Design II
16.425	Microcontroller Lab
16.442	Eng Applications of C++
16.469	VLSI Design (prerequisite 16.365)
16.475	Automated Test Systems
16.499	Capstone Proj. (microproc. or rel proj. topic assumed))
16.501	Discrete Algebras
16.502	VLSI Design (prerequisite 16.365)
16.522	Data Structures
16.524	Programming Languages
16.545	Coding Theory
16.561	Computer Architecture and Design
16.563	Systems Programming

16.574 Advanced Logic Design

Note that students in the 5 year BS/MS program may choose from similar courses to be taken for graduate credit. This specifically applies to VLSI Design (16.469 or 16.502) and Logic Design II (16.465 or 16.574). Students should be aware that the prerequisites for the 500 level graduate courses in computer engineering are the same as those for the 400 level computer concentration courses. However, an undergraduate student must have a grade point average of 3.00 or above to take any of the graduate courses.

Five Year BSEE/MSEE Combined Program

To encourage undergraduate students to continue study toward an advanced degree, the Electrical & Computer Engineering Department offers an accelerated program. If all the requirements of the department and of the Graduate School are met the students will receive the BSEE at the end of the fourth year. To complete the work for both degrees within five years, the student must make a commitment to the program before they graduate with their BS degree. Students can apply from their second semester junior year and must have a GPA of 3.00 or better.

Students in the BSEE/MSEE program should take two 500-level graduate courses in their undergraduate program. Provided that grades in these courses are "B" or better, these courses will count toward the M.S. Degree as well as the B.S. Degree.

A principal benefit of the early identification of academic goals by the student and advisor is a careful structuring of course work that permits the scheduling of prerequisite and required courses in sequence, thus effecting a considerable saving of time.

Students accepted into the program are not required to take Graduate Record Examinations.

Graduate Program

Graduate programs include the degrees of Master of Science in Electrical Engineering and Computer Engineering; the degree programs require three core

courses to be taken and are then flexible to permit specialization in one of several concentration areas. M.S. students are strongly encouraged to undertake an M.S. thesis. A master's degree will be awarded upon satisfactory completion of 30 credit hours of study in the thesis track of which the thesis provides six credit-hours. Thirty-three credit hours of study are required in the non-thesis track, including the three credit hour seminar course 16.699-Review of E&C Engineering or advanced project course 16.733. Students may pursue the Opto-Electronics Option in the M.S. program in Electrical & Computer Engineering. The Doctor of Engineering program requires a research dissertation and some additional technical and engineering management courses to be taken. A total of 63 credits are required, of which 21 are thesis credits. The Department also offers several certificate programs at the undergraduate and graduate levels. Graduate Certificate programs are offered in areas such as photonics, telecommunications, VLSI, energy conversion, communications engineering, and stochastic systems.

ELECTRICAL & COMPUTER ENGINEERING (Course Prefix:16)

Undergraduate Courses

16.100 and 16.101 Introduction to Electrical Engineering I & II

This introductory course is designed to expose students to many of the new developments in Electrical Engineering, especially those on-going in the Department. It will also provide information about co-op opportunities and career planning, while also allowing faculty in the Department to describe their courses and answer questions.

16.201 Circuit Theory I

Terminal characteristics of ideal elements, active and passive. Ohm's law and Kirchhoff's Laws. Introduction to network topology, independent variables, loop and nodal analysis with matrix methods. Definition and consequences of linearity. Superposition theorem. Concept of excitation and response. Passive equivalent circuits; active equivalent circuits. Thevenin's and Norton's theorems. Ideal inductance and capacitance, volt-ampere characteristics, energy relations, graphical differentia-

tion and integration. First-order transients: initial conditions, natural response, and natural frequencies. Network response to unit step function and unit impulse. Second-order transients: RLC circuits, natural frequencies and the complex-frequency s-plane. Open only to students accepted as sophomore level ECE majors. Prerequisites: 92.132, 95.144. Corequisite: 16.207

16.202 Circuit Theory II

Sinusoidal forcing function, complex numbers, phasors, sinusoidal steady-state conditions. Impedance, average power, reactive power and rms values. Exponential forcing function, poles and zeros in the s-plane, concept of the system function and its use in determining the forced response and natural behavior of circuits. Frequency response and resonance, reactance cancellation and concept of s-plane vectors. Thevenin's and Norton's theorems, superposition, reciprocity, and maximum power in the frequency domain. Impedance and admittance and hybrid parameters for a two-port network. Magnetic coupling, mutual inductance, ideal transformer. Prerequisite: 16.201. Corequisite: 16.208.

16.207 Basic EE I Laboratory

Experimental work designed to verify theory and to acquaint students with electrical measurement techniques: experiments on meters, bridges, and oscilloscopes. Experiments are correlated with course 16.201 and concern: resistive measurements, Kirchhoff's laws, network theorems, conservation of power and maximum power transfer, inductance and capacitance, and first and second-order transients, operational amplifiers. Corequisite: 16.201

16.208 Basic EE II Laboratory

Experimental work, designed to emphasize electrical measurement techniques of linear systems with time-varying signals. Waveform measurements with ac meters as well as advanced use of the digital oscilloscope. Experiments are integrated with course 16.202. Experiments cover: Kirchhoff's laws for phasors, magnitude and phase measurements of impedance, network theorems, frequency response, pole and zero location, resonance, inductance, statistical variation of components, modeling with MATLAB. Prerequisite: 16.207. Corequisite: 16.202

16.211 Fundamentals of Electricity I

An introduction to direct current and alternating current analysis of electric circuits, with emphasis on energy and power. Design and use of multirange voltmeters, ammeters, and ohmmeters. Use of bridges and oscilloscopes. Phasor analysis of AC circuits, Trigonometric Fourier series, and BODE plots. Transformers, relays, and solenoids. Mechanical analogs and magnetic analogs with the application of Fourier and BODE techniques. DC and AC motors and generators. Residential circuits, and equipment protection. Introduction to digital logic including minimization techniques. Availability and cost of instruments and components is stressed throughout this course. Not for EE majors. Prerequisites: 92.132

16.212 Fundamentals of Electricity Laboratory for 16.211

16.214 Fundamentals of Electricity
Similar to 16.211 but tailored for Sound Recording Technology students

16.216 Digital Control Programming

An introduction to programming in a high-level language, with emphasis on applications in electrical and computer engineering. Representative applications include problems commonly encountered in electrical engineering such as root finding, solution of systems of linear equations, and using computers for control. The course uses a modern programming language such as C or C++, and teaches fundamental programming concepts including: control flow, simple data structures, subprograms, and file I/O.

16.217 Microprocessors and Assembly Language Programming

Laboratory course with accompanying lectures introducing microprocessor structure and programming. The complete instruction set of a current microprocessor is presented. Topics include binary, decimal, and hexadecimal number systems, ASCII and BCD codes, addressing modes, conditional branching, arithmetic operations, multiple precision, operations on bits, the stack, and subroutines. A floating point subroutine library and monitor routines for communicating with the terminal are exploited, and a number of useful algorithms are presented. Machine language is used prior to introducing assembly language to expose the student

to basic internal microprocessor operations. The course terminates with a substantial design project based on an appropriate data structure. Prerequisite: 25.108

16.233 Principles and History of Radio

Intended primarily for students majoring in the liberal arts. The course develops the theory of electricity from an historical perspective. Sufficient background in circuit theory, resonance, field theory and radio waves is given to provide an understanding of the principles of radio from its antecedents in the nineteenth century through the invention of the transistor in the mid twentieth century. The fundamental contributions of, for example Volta, Oersted, Morse, Maxwell, Faraday, Hertz, Lodge, and Marconi are considered. In the present century the technical advances of such figures as de Forest, Fleming, Fessenden, Armstrong and Shockley are studied. The growth, regulation and culture of American broadcasting are also central to the course. Laboratory work is required and students may use this course toward fulfilling the General Education (science/experimental component) requirement of the University. Not open to students in the College of Engineering. Prerequisite: none.

16.265 Logic Design I

Number systems and computer codes. Switching algebra. Canonical and fundamental forms of switching functions. Minimization of switching functions. Two-level and multi-level digital circuits. Decoder, encoders, multiplexers, and demultiplexers. Design of combinational circuits using SSI, MSI and programmable logic devices. Latches and flip-flops. Registers and counters. Analysis and synthesis of synchronous sequential circuits. Design of more complex circuits: datapath and control. Prerequisite: 25.107/108 or 91.101

16.301 Technology for Health Care

An introduction to electrical engineering principles and technology and their direct application to health profession issues. Topics include electrical circuit elements, basic principles of dc and ac circuits, static electricity and electrical isolation issues, transducers and signal conditioning, the distinction between analog and digital signals, D/A and A/D converters, binary numbers, logic operations, microprocessors, microcomputers. A study of

some representative medical instruments. Not for EE Majors.

16.311 Electronics I Laboratory

Laboratory experiments coordinated with the subject matter of 16.365.

Characteristics and use of electronic instrumentation for making measurements on electronic circuits. Methods of designing and characterizing diode and transistor circuits. Analysis of performance characteristics of digital and linear semiconductor circuits, including logic elements and amplifiers. Design and construction of circuits using monolithic op amps. Co-requisite: 16.365.

16.312 Electronics II Laboratory

Laboratory experiments coordinated with the subject matter of 16.366. High-frequency characteristics of transistors and transistor amplifiers. Feedback in electronic circuits. Electronic oscillators. Differential amplifiers. Properties of linear IC operational amplifiers and their application in amplifier circuits and waveform generation circuits. Linear circuit design and analysis. Prerequisite: 16.311. Co-requisite: 16.366.

16.333 Chemistry and Engineering of Electronic Materials

The production and processing of materials into finished products constitutes a large part of the present economy. To prepare students for to use of a variety of traditional and new materials, this course will cover: atomic structure and chemical bonding, crystal geometry and defects, mechanical properties and phase diagrams of metals and alloys, electrical and optical properties of electronic materials.

16.355 Electromechanics

Alternating current circuits, three phase circuits, basics of electromagnetic field theory, magnetic circuits, inductance, electromechanical energy conversion. Ideal transformer, iron-core transformer, voltage regulation, efficiency equivalent circuit, and three phase transformers. Induction machine construction, equivalent circuit, torque speed characteristics, and single phase motors. Synchronous machine construction, equivalent circuit, power relationships phasor diagrams, and synchronous motors. Direct current machines construction, types, efficiency, power flow diagram, and external characteristics. Prerequisites: 16.202 and 95.144

16.360 Engineering Electromagnetics I

Waves and Phasors, Transmission lines as Distributed Circuits, Smith Chart Calculations, Impedance Matching, Transients on Transmission Lines, Vector Analysis, Electrostatics and Capacitance, Steady current flow in conductors and Resistance, Magnetostatics and Inductance. Prerequisites: 92.236, and 16.201

16.362 Signals & Systems I

A study of various continuous voltage/current time functions and their applications to linear time-invariant electrical systems. Review of pertinent topics from 16.202 such as system functions, S-plane concepts and complete responses. Step, ramp and impulse responses of linear circuits. Sifting integrals. Types of analog filter responses. Designs for Butterworth and Chebishev filters. Fourier Analysis, Fourier Transforms, Convolution, Laplace Transforms, Parseval's Theorem. A large portion (30-40%) is devoted to teaching the students communication skills and the use of MATLAB for solving homework problems. A MATLAB based text is assigned to the course. Prerequisites: 92.236 and 16.202

16.363 Signals & Systems II

This course employing probabilistic methods of signal and system analysis (an extension of 16.362) considers the random nature of the world faced by electrical engineers. The course addresses the issues of the nature and characterization of random events, especially noise and its effect on systems. The course is divided into three parts, 1) Introduction to discrete and continuous probability 2) Introduction to statistical methods and 3) random signals and noise and the response of linear systems to random signals. There will be frequent use of Monte-Carlo simulation techniques on the computer to allow students to verify theory and to learn the important technique of simulation. Applications of theory to manufacturing and reliability, noise analysis, spectral analysis, data communication, data collection, and system design will be presented. Prerequisite: 16.362.

16.364 Engineering Mathematics

Complex numbers, Argand plane, derivatives of complex numbers, limits and continuity, derivative and Cauchy Riemann conditions, analytic functions, integration

in the complex plane, Cauchy's integral formula, infinite series for complex variables, Taylor series, Laurent series, residue theory, evaluation of integrals around indented contours. Linear vector spaces, matrices and determinants, eigenvalues and eigenvectors. Prerequisite: 92.236, 16.201

16.365 Electronics I

A brief introduction to solid-state physics, leading to discussion of physical characteristics of p-n junction diodes, bipolar junction transistors, and field-effect transistors: active, saturated, and cut-off models of bipolar transistors and triode, constant current, and cut-off models of MOSFETs. Circuit models for diodes, and diode applications. Circuit models for transistors, and transistor applications in bipolar and MOS digital circuits and low-frequency amplifier circuits. Analysis of digital circuits and linear circuits based on application of circuit models of devices and circuit theory. Prerequisites: 16.202. Corequisite: 16.311

16.366 Electronics II

A continuation of 16.365 with discussion of differential amplifiers, operational amplifiers and op amp applications, transistor amplifiers at very high frequencies; direct-coupled and band pass amplifiers; small and large signal amplifiers; feedback amplifiers and oscillators. Active filters, wave form generation circuits including Schmitt trigger, multiplexers, and A/D and D/A converters. Circuit design employing integrated circuit operational amplifiers and discrete devices. Circuit analysis using SPICE. An electronic design project constitutes a major part of the course. Prerequisite 16.365. Co-requisite: 16.312

16.399 Capstone Proposal

This course discusses and presents the non-technical tools and procedures for bringing a potential product from the idea or basic concept stage through final design and to market. Fundamentals of market research, product safety and liability concerns, necessary technical communication skills. Economic concerns, patent, application procedures, design procedures and people skills necessary to be part of an engineering team. Prerequisite 16.366, 16.360, 16.363 and less than 30 credits remaining at the time of registration to complete major.

16.401 Digital Signal Processing

Discrete-time signals and systems, definitions, linear shift invariant systems, linear difference equations, time domain analysis, sampling, linear convolution. Frequency domain analysis of discrete-time systems, the z-transform. discrete Fourier series and transforms, the Fast Fourier transform. Infinite-Impulse Response and Finite Impulse Response filters. Filter structures, quantization effects. Several applications and demonstrations using MATLAB. Prerequisite: 16.362.

16.403 Microwave Design Theory

An introductory course in the analysis and design of passive microwave circuits beginning with a review of time-varying electromagnetic field concepts and transmission lines. Smith Chart problems; single and double stub matching; impedance transformer design; maximally flat and Cheby-chev transformers; microstrip transmission lines, slot lines, coplanar lines; rectangular and circular waveguides; waveguide windows and their use in impedance matching; design of directional couplers; features of weak and strong couplings; microwave filter design; characteristics of low-pass, high-pass, band-pass, band-stop filter designs; two-port network representation of junctions; Z and Y parameters, ABCD parameters, scattering matrix; microwave measurements; measurement of VSWR, complex impedance, dielectric constant, attenuation, and power. A design project constitutes a major part of the course. Prerequisite: 16.461.

16.409, 410, 411, 412 Project Laboratory

The purpose of this course is to provide an opportunity for qualified Electrical Engineering students to investigate specific areas of interest. The actual project undertaken may be software or hardware oriented. The most important characteristics of the projects are that the end results represent independent study and that they are research and development oriented, and that they are accomplished in an engineering environment. Design reviews and progress reports are expected for each project. A final formal report to be permanently filed in the EE Department is required for each project. Prerequisites: At least three courses from 16.355, 360, 362, 365 and 366.

16.413 Linear Feedback Systems

Concepts of feedback; open loop and closed loop systems. Feedback in electrical and mechanical systems. Mathematical models of systems and linear approximations. Transfer functions of linear systems, block diagrams and signal flow graphs. Sensitivity, control of transient response, disturbance signals. Time domain performance: steady state errors, performance indices. Stability related to s-plane location of the roots of the characteristic equation. Routh-Hurwitz criterion. Graphical analysis techniques: root locus, frequency response as polar plot and Bode diagrams. Closed loop frequency response. A control system design project is included in the course. Prerequisites: 16.362 and 16.364.

16.416 Amplifiers

An integrated treatment of the analysis and design of electronic amplifiers. Typical amplifier specifications such as noise figure, intermodulation, intercept point, power dissipation, frequency response, gain compression point, and VSWR are discussed in detail. Emphasis is then placed on the choosing of electronic devices and circuit configuration based on amplifier and system design objectives. A design project constitutes a major portion of the course. Prerequisite: 16.366.

16.417 Real Time Digital Signal Processing

This course provides an introduction to real-time digital signal processing techniques using the TMS320C3x floating point and TMS320C5x fixed point processors. The architecture, instruction set and software development tools for these processors will be studied via a series of C and assembly language computer projects where real-time adaptive filters, modems, digital control systems and speech recognition systems are implemented. Prerequisite: 16.362

16.418 Wireless Communications

Cellular systems and design principles, co-channel and adjacent channel interference, mobile radio propagation and determination of large scale path loss, propagation mechanisms like reflection, diffraction and scattering, outdoor propagation models, Okumura and Hata models, small scale fading and multipath, Doppler shift and effects, statistical models for multipath, digital modulation techniques QPSK, DPSK, GMSK, multiple access techniques,

TDMA, FDMA, CDMA, spread spectrum techniques, frequency hopped systems, wireless systems and worldwide standards. Prerequisite 16.360

16.420 Computers in Engineering Analysis and Design

An advanced programming course which considers the digital computer as a tool for solving significant engineering problems. The course is based on a specific area in engineering which will be selected from such topics as digital and image processing, spectral estimation, optimization techniques, etc. Typical algorithms related to the specific topic will be studied. User oriented programs or subroutine packages will be developed in a project.

Prerequisites: senior standing in EE

16.425 Microprocessor Applications Laboratory

Laboratory course with accompanying lectures introducing microprocessor programming and interfacing techniques. Topics include microprocessor instruction sets, addressing modes, branching, arrays and stacks, sub-routines, parallel I/O, interrupts, A/D and D/A converters, programmable timers, and interfacing signal sources and loads such as shaft encoders and stepper motors. Two design projects constitute a significant part of the course. Prerequisite: 16.217 or 91.203, and 16.265

16.428 Alternate Energy Sources Photovoltaics:

PV conversion, cell efficiency, cell response, systems and applications. Wind Energy conversion systems: Wind and its characteristics; aerodynamic theory of windmills; wind turbines and generators; wind farms; siting of windmills. Other alternative energy sources: Tidal energy, wave energy, ocean thermal energy conversion, geothermal energy, solar thermal power, satellite power, biofuels. Energy storage: Batteries, fuel cells, hydro pump storage, flywheels, compressed air.

16.431 RF Design

Two-port network parameters, Smith chart applications for impedance matching, transmission line structures like stripline, microstrip line and coaxial line, filter designs for low-pass, high-pass and band-pass characteristics, amplifier design based on s-parameters, bias network designs, one port and two port oscillator circuits, noise in RF systems.

16.434 Active Network Theory

A study of active inductorless networks with emphasis on design and implementation. The course will cover the following subjects: approximation theory, the operational amplifier, the gyrator, the negative impedance converter, analysis of basic second-order active building blocks, the biquad building block, the state-variable filter, and the design of filters. The course includes a detailed design project. Prerequisite: 16.366.

16.439 Introduction to Communication Theory

An introduction to the study of time and frequency domain characteristics of signals arising in communications systems. Fourier analysis, discrete transform, correlation functions, power and energy density spectra. Time and frequency characteristics of thermal noise and random signals in data and noise communications. Spread spectrum concepts. Signal to noise ratio. Amplitude modulation, frequency modulation. Digital modulation, PAM, PCM, bandwidth control, time division multiplexing, transmission of binary data in noise. Prerequisite: 16.362.

16.440 Communication Systems

Analysis of the performance and operating characteristics of communication systems from the viewpoint of probability theory. Concentration on digital systems. Fundamentals of probability, expectation operator, Gaussian random variable. Markov processes, fundamentals of random processes. Discretization of analog signals. Fundamentals of information theory and coding. PN coding. Transmission of binary data in noise (matched filters). Optimal filters, tradeoffs of bandwidth power, and coding complexity in digital transmission. Applications. Hardware and/or simulation projects. Prerequisite: 16.362.

16.442 Engineering Applications of C++ Programming Language

This course covers the C++ programming language, programming techniques, program structure, data types including pointers, operators including bit manipulation and I/O methods. Programming assignments will be run on the VAX system and will focus on the uses of arrays, classes and pointers. The emphasis will be on the writing of portable programs that are well organized, readable and work correctly.

Applications are chosen from a variety of engineering problems. A design project is required in the course. Prerequisite: 16.217.

16.443 Power Systems Analysis

An intermediate course in analysis and operation of electrical power systems using mathematical techniques including applied calculus and matrix algebra. Topics include network reductions and representation of lines, generators, and transformers, network topology and transform methods. An introduction to protection and relaying is included. Symmetrical components will be introduced with application to polyphase systems. A design project is a major portion of the course. Prerequisite: 16.355.

16.445 Analog Devices & Techniques

A survey of analog devices and techniques, concentrating on operational amplifier design and applications. Operational amplifier design is studied to reveal the limitations of real opamps, and to develop a basis for interpreting their specifications. Representative applications are covered, including: simple amplifiers, differential and instrumentation amplifiers, summers, integrators, active filters, nonlinear circuits, and waveform generation circuits. A design project is required. Prerequisite: 16.366.

16.460 Computational Electromagnetics

Formulation of electromagnetic problems for computer solution. Finite difference, finite element, moment, finite difference time-domain methods. Computer solution of several problems of current-interest using available software packages. Prerequisite: 16.360

16.461 Engineering Electromagnetics II

Continuation of Magnetostatics, Maxwell's Equations for Time-varying Fields, plane waves: time-harmonic fields, polarization, current flow in good conductors and skin effect, power density and poynting vector, wave reflection and transmission; Snell's Law, fiber optics, Brewster angle, radiation and simple antennas, electromagnetic concepts involved in a topical technology in development. Prerequisite: 16.360 and 16.364

16.462 Antenna Theory and Design

An introduction to properties of individual

antennas and arrays of antennas. Retarded potentials, dipoles of arbitrary length, radiation pattern, gain, directivity, radiation resistance. The loop antenna. Effects of the earth. Reciprocity, receiving antennas, effective length and area. Moment methods. Arrays: collinear, broadside, endfire. Array synthesis. Mutual coupling. Log-periodic and Yagi arrays. Radiation from apertures: the waveguide horn antenna, parabolic dish. Antenna noise temperature. Numerical software packages. A design project is required in the course. Prerequisite: 16.461.

16.463 Bioelectric Phenomena

This course presents mathematical techniques that provide a quantitative base for a wide range of observed bioelectric phenomena. Specific topics include biological membrane phenomena, the propagating neuron action potential, volume conductor analysis and electrocardiography. Computer projects deal with phase plane analysis of a Hodgkin-Huxley membrane model and the calculation of an equivalent cardiac generator from electro-cardiogram data. Prerequisite: 16.360. Corequisite: 16.413.

16.465 Logic Design II

Number systems and codes. Error detecting and correcting codes. Map-entered variables. Minimization by Quine-McCluskey method. Multiple-output circuits. Timing hazards and hazard-free designs. Analysis and synthesis of synchronous and asynchronous sequential circuits. Races and essential hazards. Primitive flow tables. Flow table reductions and state assignments. Designs using MSIs. Programmable logic devices: ROMs, PLAs, PALs and PLSs. A design project is required in the course. Prerequisites: 16.217 and 16.265.

16.468 Electro-optic Systems

The course is divided into classical optics and modern (quantum) optics. Topics include geometrical and Fourier optics, diffraction and interference, coherence of light, interaction of radiation with matter and polarization states. An introduction to quantum mechanics is given followed by the topics of laser theory and design, sources and detectors, including semiconductor devices, and nonlinear electro-optics. Prerequisites: 16.360 and 16.362.

16.469 VLSI Design

Introduction to CMOS circuits including transmission gate, inverter, NAND, NOR gates, MUXes, latches and registers. MOS transistor theory including threshold voltage and design equations. CMOS inverter's DC and AC characteristics along with noise margins. Circuit characterization and performance estimation including resistance, capacitance, routing capacitance, multiple conductor capacitance, distributed RC capacitance, multiple conductor capacitance, distributed RC capacitance, switching characteristics incorporating analytic delay models, transistor sizing and power dissipation. CMOS circuit and logic design including fan-in, fan-out, gate delays, logic gate layout incorporating standard cell design, gate array layout, and single as well as two-phase clocking. CMOS test methodologies including stuck-at-0, stuck-at-1, fault models, fault coverage, ATPG, fault grading and simulation including scan-based and self test techniques with signature analysis. A project of modest complexity would be designed to be fabricated at MOSIS. Prerequisite: 16.265 and 16.365

16.470 VLSI Fabrication

Fabrication of resistors, capacitors, p-n junction and Schottky Barrier diodes, BJT's and MOS devices and Integrated circuits. Topics include: silicon structure, wafer preparation, sequential techniques in micro-electronic processing, testing and packaging, yield and clean room environments. MOS structures, crystal defects, Fick's laws of diffusion; oxidation of silicon, photolithography including photoresist, development and stripping. Metallization for conductors, Ion implantation for depletion mode and CMOS transistors for better yield speed, low power dissipation and reliability. Students will fabricate circuits using the DSIPL Laboratory. Prerequisite: 16.365.

16.473 Power Electronics

A one-semester course with emphasis on the engineering design and performance analysis of power electronics converters. Topics include: power electronics devices (power MOSFETs, power transistors, diodes, silicon controlled rectifiers SCRs, TRIACs, DIACs and Power Darlington Transistors), rectifiers, inverters, ac voltage controllers, dc choppers, cycloconverters, and power supplies. The course

includes a project, which requires that the student design and build one of the power electronics converters. A demonstrative laboratory to expose the students to all kinds of projects is part of the course. Prerequisites: 16.355, 16.366.

16.474 Principles of Solid-State Devices

Principles of Solid State Devices: Crystal properties and growth of semi-conductors, atoms and electrons, Bohr's model, quantum mechanics, bonding forces and energy bands in solids, charge carriers in semi-conductors, drift of carriers in electric and magnetic fields, carrier lifetime and photo-conductivity, junctions, forward and reverse bias, reverse bias breakdown (Zener effect), tunnel diodes, photodiodes, LED, bipolar junction transistors, field effect transistors. A design project is included in the course. Prerequisite: 16.365.

16.475 Automated Test Systems

A design-oriented introduction to the techniques of modern automatic test systems, covering both hardware and software. Topics include: automated testing in engineering and manufacturing; the IEEE-488 instrument bus; programmable test equipment; the device under test interface; modular software development; and human engineering and ethical considerations. The course includes a project in which students develop a complete automated test system for some real device. Student designs are implemented in the EE department's Automated Test System Laboratory. During the project students maintain project schedules and conduct design reviews to critique each other's designs. Completed projects are demonstrated and thoroughly documented. Prerequisites: 16.366

16.476 Photovoltaics

An introductory course in photovoltaics concentrating on solar cells for energy conversion. Solar radiation and conversion efficiency. Photovoltaic materials, energy bands and carrier transport, semi-conductors and conductors. P-n junctions, depletion region, current voltage characteristics, efficiency. Heterojunctions and thin film solar cells. Balance of system components for a photovoltaic system including electrical storage. Barrier to extensive use of photo-

voltaic systems. Prerequisite: 92.132 or consent of instructor.

16.490 Fiber Optic Communications and Networks

Optical fiber; waveguide modes, multi-mode vs single mode; bandwidth and data rates; fiber losses; splices, couplers, connectors, taps and gratings; optical transmitters; optical receivers; high speed optoelectronic devices; optical link design; broadband switching; single wavelength systems (FDDI, SONET, ATM); coherent transmission; wavelength division multiplexing and CDMA; fiber amplifiers. Prerequisites: 16.360, 16.362 or permission of instructor.

16.491 Industrial Experiences I, II and III.

This three credit course is for co-op or industrial experience. It may be taken three times and the co-op internship should be for at least 500 hours in order to be eligible for credit. Only 3 credits may be used toward the BSEE degree. Registration for this course is conditional on the approval of the Department Co-op co-ordinator. A grade of Satisfactory or Unsatisfactory is given.

16.499 Capstone Project

The purpose of the CAPSTONE Project is to provide the student with a design experience which resembles entry level engineering assignments. It is expected that the project encompass a minimum of three technical areas within the EE discipline, and include some aspects of each step in the development of a marketable product i.e. Research, Design & Development, Manufacture, Marketing & Service. A formal technical report must be submitted prior to the submission of a course grade. Prerequisite 16.399.

Primarily for BS/MS or Graduate Students**16.500 Comprehensive Study of EE**

This course is designed to help those students who have been out of academia for a while and who are preparing for the doctoral qualifying examinations.

16.501 Discrete Algebras

A comprehensive course addressing the diversity of discrete algebraic systems needed in digital system synthesis and analysis. Review of sets, mappings, func-

tions and relations. Abstract algebraic systems including lattices, groups, rings and discrete fields. Combinatorial analysis, event space algebra, solution of difference equations, discrete limits and complexity functions, elementary discrete and concrete functions. Prerequisites: Calculus and Laplace Transforms

16.502 VLSI Design

Introduction to CMOS circuits including transmission gate, inverter, NAND, NOR gates, MUXes, latches and registers. MOS transistor theory including threshold voltage and design equations. CMOS inverter's DC and AC characteristics along with noise margins. Circuit characterization and performance estimation including resistance, capacitance, routing capacitance, multiple conductor capacitance, distributed RC capacitance, multiple conductor capacitance, distributed RC capacitance, switching characteristics incorporating analytic delay models, transistor sizing and power dissipation. CMOS circuit and logic design including fan-in, fan-out, gate delays, logic gate layout incorporating standard cell design, gate array layout, and single as well as two-phase clocking. CMOS test methodologies including stuck-at-0, stuck-at-1, fault models, fault coverage, ATPG, fault grading and simulation including scan-based and self test techniques with signature analysis. A project of modest complexity would be designed to be fabricated at MOSIS. Prerequisite: 16.265 and 16.365

16.503 Solid-State Physical Electronics I

A design of semiconductor device and manufacturing technology is linked to the solid state physics principles in this course. Topics covered: The electronic structure of the atom, wave-particle duality of moving electrons. Schrodinger equation for periodic crystalline structure. Band theory of semiconductors. Brillouin zones. Statistics of electrons and holes. Kinetic effects: electrical conductivity, Hall effect, magnetoresistance. Optical properties: photoconductivity, light absorption and emission. Thermal properties including thermal conductivity, thermal EMF, recombination processes and role of defects. Prerequisite: 16.365 or consent of the instructor.

16.505 Microwave Electronics

Review of p-n junction theory, depletion

layer width and junction capacitance, Schottky barrier diodes, pin diodes and applications in switches and phase shifters, varactors and step recovery diodes, tunnel diodes and circuits, Gunn devices and circuits, avalanche diodes, IMPATT, TRAPATT and BARRITT diodes, microwave bipolar junction transistors (BJT) and field effect transistors (FET), small signal amplifier design, new devices like HEMT and Si-Ge devices, travelling wave tubes and klystrons.

16.506 Antenna Theory and Design

An introduction to properties of individual antennas and arrays of antennas. Retarded potentials, dipoles of arbitrary length, radiation pattern, gain, directivity, radiation resistance. The loop antenna. Effects of the earth. Reciprocity, receiving antennas, effective length and area. Moment methods. Arrays: collinear, broadside, endfire. Array synthesis. Mutual coupling. Log-periodic and Yagi arrays. Radiation from apertures: the waveguide horn antenna, parabolic dish. Antenna noise temperature. Numerical software packages. Prerequisite: 16.461.

16.507 Electromagnetics

This is a graduate core course, which serves the needs of students who study electromagnetics as a basis for a number of electromagnetic technologies including photonic technologies. Study of Electromagnetic Wave Interactions with Bounded Simple Media: transmission lines, Green's function, fibers, conducting waveguides and cavity resonators, Plane waves in Complex Electromagnetic Materials: plasmas, dispersive dielectrics, mixing formulas, optical waves in metals, superconductors, chiral media, crystals, magnetized plasma and time-varying media, layered and periodic media. Prerequisite: 16.461.

16.508 Quantum Electronics for Engineers

Introduction to the fundamental postulates of quantum theory: Planck's quantization hypothesis; wave-particle duality; time-dependent & time-independent Schrodinger's Equation; simple quantum mechanical systems. Radiation and quanta; quantization of the radiation field and cavity modes; absorption and emission of radiation; coherence functions; coherent states; importance of quantum fluctuations and quantum nature of light; laser

amplifiers and amplifier nonlinearity; electromagnetics and quantum theory of laser oscillators; photons in semiconductors; semiconductor photon sources and detectors.

16.509 Linear Systems Analysis

Correlation and Circular convolutions. Concepts of orthogonality and Gram-Schmidt orthogonalization procedure. Fourier series and Fourier transforms (FT): convergence properties; applications to linear systems including modulation, sampling and filtering. Hilbert transforms (HT) and analytic signals. Bilateral Laplace transforms (LT): convergence properties. Contour integration methods applied to FT, HT and LT. Discrete-time Fourier series and Fourier transforms including complex convolution: applications to linear systems. Discrete Fourier transforms and Fast Fourier algorithm. Z-transforms: convergence properties, solution of difference equations, application to linear systems. Correlation. Prerequisite: 16.362.

16.510 Digital Signal Processing

Review of Z-Transforms and solutions of linear difference equations. Digital filter structures, parameter quantization effects and design techniques. FFT and Chirp Z-Transform methods. Discrete Hilbert Transforms, minimum-phase sequences and their application to Homomorphic Signal Processing and calculation of Complex Cepstrum. Prerequisite: 16.509.

16.511 Digital Image Processing

Introduction to the analytical principles and methods of image representation and image processing; a series of computer projects that demonstrate these principles. Image sampling, image transforms, image enhancement and image data compression techniques; implementation of image processing algorithms based on fractal image models. Prerequisite: 16.509 or 16.510

16.512 Electronic Materials I

Introduction to types of electronic materials, including semiconducting, optical, superconducting, and magnetic materials. Material quality vs. device performance. Defects such as point defects, dislocations, phase boundaries, and second phases, and their electronic effects. The phase rule, phase diagrams, and thermodynamics. Introduction to crystallography. Physical basis for quantum behavior in

solid state devices. Bulk and thin film materials preparation - starting materials, crystal growth, and control requirements. Each student will undertake an individual project reviewing preparation methods for a material of industrial or research importance.

16.513 Control Systems

System representations, state variables, transfer functions, controllability and observability, phase variables, canonical variables, representation of nonlinear systems, Lagrange's equations, generalized co-ordinates, time response of linear systems, state transition matrix, Sylvester's expansion theorem, stability and state function of Liapunov, transient behavior estimation, optimal control, state function of Pontryagin, variational calculus, Hamilton Jacobi method, matrix Riccati equation, linear system synthesis.

Prerequisites: 16.413

16.514 Power Systems Analysis

An intermediate course in analysis and operation of electrical power systems using mathematical techniques including applied calculus and matrix algebra. Topics include network reductions and representation of lines, generators, and transformers, network topology and transform methods. An introduction to protection and relaying is included. Symmetrical components will be introduced with application to polyphase systems. Prerequisite: 16.355

16.515 Power Electronics

Design and performance analysis of rectifiers, inverters, DC chopper, AC voltage controllers, cycloconverters, and power supplies. The course includes a design project in the laboratory. Prerequisites: 16.355 and 16.366

16.516 Advanced Machine Theory

Electromechanical energy conversion. Reference-frame theory. Dynamics of DC, induction, and synchronous machines. Unbalanced operation of induction and synchronous machines. Prerequisites: 16.355

16.517 MMIC Design and Fabrication

Introduction to GaAs MMIC processes including basic FET steps, VPIN diodes, MESFET processes, via holes and ohm contacts. Design considerations including yield, die size, process tolerances, line width precision, cycle time, reticle layout,

interconnect, die attach, testing and assembly. Layout rules including cell library, CAD formats, metal interconnects, bond wire, DC probe and RF probe pads, capacitors, rectangular inductors contact rules, alignment markers, scribe and saw pass indicators. RF test capabilities, including biasing, test constraints, design for test ability, layout, DC bias and ground pad requirements. FETs including small signal analysis, extrinsic networks, source inductance, models for gate periphery and material thickness. Power FETs including temperature dependent models and nonlinear models. MESFET switches including calculations for bias and maximum power, gate bias resistor and common switch configurations, Schottky planar diodes, PIN diodes, passive elements including metal interconnects, transmission lines, airbridges, microstrips, RF coupling and reliability issues. Thermal resistance, stability, biasing, losses and feedback effects. Design for manufacturability, including calculations on circuit sensitivity, process variations, Monte Carlo yield, and electrical parameters. Power amplifiers, including design analysis, maximum power bias and load, and power delivered to the load. Active and passive mixers including theory of single-gate FET and dual gate FET. Balanced mixers including basic structures, hybrids, double balanced passive mixer, double balanced FET mixer and measurements.

16.519 Engineering of Submicron Machines

Recently fabrication of Very Large Scale Integrated circuits has spun-off a new technology of micro-machines (MEMS) and sensors on a semiconductor wafer. These new devices are ideally located next to a microprocessor on the same wafer or a separate chip. The data transfer to and from a miniature machine, sensor or transducer is processed and controlled on site. Topics include design of mechanical, electrical and biological transducers; properties of electronic materials; pattern generation on a semiconductor wafer; interface of a micromachine and processor; applications and markets for submicron machines.

16.520 Computer-Aided Engineering Analysis

Taylor series. Number systems and error. Difference and summation calculus.

Interpolation. Definite integrals.

Differential equation modeling and stability; Predictor-Corrector and Runge-Dutta methods. Orthogonal polynomials.

Discrete transforms. Roots of polynomials. Zeros and stationary points of single variable functions. Gradient, quasi-Newton and conjugate gradient methods of optimization. Prerequisite: 92.234

16.521 Real-time Digital Signal Processing

This course provides an introduction to real-time digital signal processing techniques using the TMS320C3x floating point and TMS320C5x fixed point processors. The architecture, instruction set and software development tools for these processors are studied via a series of C and assembly language computer projects where real time adaptive filters, modems, digital control systems and speech recognition systems are implemented. Preqs are C and/or assembly language and 16.510 or an equivalent course in one-dimensional signal processing that included discrete Fourier analysis techniques, random discrete signals and cepstral analysis techniques.

16.522 Data Structures

Character strings, character substring searches; lists, their storage structures and uses; trees, tree searches, and storage concepts; compiling, Polish strings, translating from infix to postfix and prefix, conversion to machine code. Prereq: FORTRAN and Pascal or instructor's permission.

16.524 Programming Languages

Syntax and semantics of programming languages. Fundamental concepts of control structures, modularity, scope of identifiers, recursion, and data structures. Examples of real programming languages such as FORTRAN, Pascal, LISP, APL, C++, and ADA. Prerequisite: FORTRAN, Pascal, or C.

16.528 Alternate Energy Sources

Photovoltaics: PV conversion, cell efficiency, cell response, systems and applications. Wind Energy conversion systems: Wind and its characteristics; aerodynamic theory of windmills; wind turbines and generators; wind farms; siting of windmills. Other alternative energy sources: Tidal energy, wave energy, ocean thermal energy conversion, geothermal energy, solar thermal power, satellite power, bio-

fuels. Energy storage: Batteries, fuel cells, hydro pump storage, flywheels, compressed air. Course also is listed as 24.528.

16.529 Electric Vehicle Technology

Electric vehicle VS internal combustion engine vehicle. Electric vehicle (EV) saves the environment. EV design, EV motors, EV batteries, EV battery chargers and charging algorithms, EV instrumentation and EV wiring diagram. Hybrid electric vehicles. Fuel cells. Fuel cell electric vehicles. The course includes independent work

16.531 RF Design

Two-port network parameters, Smith chart applications for impedance matching, transmission line structures like stripline, microstrip line and coaxial line, filter designs for low-pass, high-pass and band-pass characteristics, amplifier design based on s-parameters, bias network designs, one port and two port oscillator circuits, noise in RF systems.

16.532 Computational Electromagnetics

Formulation of electromagnetic problems for computer solution. Variational principles in electromagnetics. Method of moments. Applications in electrostatics, wire antennas, waveguides and cavities. Simple scattering problems. Finite difference methods. Finite element method. Prerequisite: 16.461.

16.533 Microwave Engineering

An introductory course in the analysis and design of passive microwave circuits beginning with a review of time-varying electromagnetic field concepts and transmission lines. Smith Chart problems; single and double stub matching; impedance transformer design; maximally flat and Cheby-chev transformers; microstrip transmission lines, slot lines, coplanar lines; rectangular and circular waveguides; waveguide windows and their use in impedance matching; design of directional couplers; features of weak and strong couplings; microwave filter design; characteristics of low-pass, high-pass, band-pass, band-stop filter designs; two-port network representation of junctions; Z and Y parameters, ABCD parameters, scattering matrix; microwave measurements; measurement of VSWR, complex impedance, dielectric constant, attenuation, and power. A design project constitutes a

major part of the course. Prerequisite: 16.461.

16.543 Introduction to

Communication Theory

Information transmission and deterministic signals in time and frequency domains. Relationship between correlation and power or energy spectra. Statistical properties of noise. Spectral analysis and design of AM, FM and pulse modulation systems, continuous and discrete. AM, FM, and various pulse modulation methods, in the presence of noise. Digital modulation & demodulation technique. Prerequisite: 16.362 16.363 or 16.584 or equivalent.

16.544 Theory of Communication II

This course presents advanced topics in modern communication not covered in other courses. It is oriented towards applied modern digital communication and telecommunications. Topics include: Convolutional Coding and Decoding using the Viterbi Algorithm. Trellis code modulation for bandwidth and signal limited channels. Ungerboeck set partitioning, Spread Spectrum and applications to personal communication systems, Discrete Multi-tone modulation for dispersive channels, DSP based implementation of advanced modulation, Characterization of communication channels and design of signals. Prerequisite: 16.543 or Permission of Instructor.

16.545 Coding Theory

Concepts and recent developments in the use of codes for error control in data handling systems. Encoding and decoding procedures and their implementation in computational algorithms and hardware organizations are investigated in detail. Prerequisite: Permission of Instructor

16.548 Information Theory

Probabilistic measure of information. Determination of the information handling capacity of communication channels and fundamental coding theorems. Introduction to information coding and error correcting codes. Prerequisite: 16.471 92.386 or equivalent.

16.549 Introduction to Intelligent Transportation Systems

Introduction to the technologies collectively known as intelligent transportation systems, including communications, controls, navigation and computer applica-

tions, safety and collision avoidance, and transmission media from acoustic waves to microwaves. The course covers prospects for future development of ITS and discusses systems engineering and technical experience needed to design national transportation system architectures. The course explores new cooperative and interactive approaches among engineers and vehicle manufacturers to solve technical problems posed by implementing ITS. It includes discussion of ITS America, the historic background of transportation, public and private transportation issues, technical and traffic management issues, and areas of product development and applications, particularly for defense contractors. It will give managers technical vocabulary enabling them to make informed choices on managing education in the field. Included is discussion of career areas involving ITS. An engineering or technical background would be useful for maximum benefit from the course.

16.555 Applications of Microwaves and Lasers in Medicine

Microwave hyperthermia, implantable radiators and techniques; EM techniques for medical diagnostics: lung water measurement, blood flow measurements, arterial wall movement by microwave Doppler radar, microwave radiometry and its uses in breast cancer; RF-field interactions with biological systems: electrical properties and biophysical mechanisms; introduction to medical optics and lasers: laser characteristics, laser surgery, optical fiber delivery systems, endoscopes, optical fiber sensors and spectrometers, phototherapy, photon migration and imaging through tissue, coherence tomography, biometrics, ophthalmic applications, laser tweezers

16.561 Computer Architecture and Design

Structure of computers, past and present: first, second, third and fourth generation. Combinatorial and sequential circuits. Programmable logic arrays. Processor design: information formats, instruction formats, arithmetic operations and parallel processing. Hardwired and microprogrammed control units. Virtual, sequential and cache memories. Input-output systems, communication and bus control. Multiple CPU systems. Pre-requisites: 16.217, 16.265.

16.563 System Programming

System programming structures with emphasis on re-entrant programming and pure procedures. Nested calls, push-down stacks and queues. Re-entrant interrupt programming, activation records and program sharing. Memory allocation by absolute and relocatable loaders. Macro languages, processes and assemblers. Prerequisite: 16.217.

16.565 Analog Devices & Techniques

A survey of analog devices and techniques, concentrating on operational amplifier design and applications. Operational amplifier design is studied to reveal the limitations of real op-amps, and to develop a basis for interpreting their specifications. Representative applications are covered, including: simple amplifiers, differential and instrumentation amplifiers, summers, integrators, active filters, nonlinear circuits, and waveform generation circuits. A design project is required. Prerequisite: 16.366

16.568 Electrooptics and Fiber Optics

Introduction to optoelectronics and laser safety; geometrical optics; waves and polarization; Fourier optics; coherence of light and holography; properties of optical fibers; acousto-optic and electro-optic modulation; elementary quantum concepts and photon emission processes; optical resonators; Fabry Perot etalon; laser theory and types; review of semiconductor lasers and detectors; nonlinear optics. Prerequisite: 16.360.

16.569 Electrooptics and Infrared Systems

Introduction to optoelectronics and laser safety; ir sources and blackbodies, characterization of sources, ir signatures and camouflage, geometrical optics; waves and polarization; optical alignment techniques, diffraction, Fourier optics; coherence of light; elementary quantum concepts and photon emission processes; optical resonators; laser theory and types; review of semiconductor lasers and detectors; optical design for ir imaging, testing ir systems, focal plane arrays. Prerequisite: 16.360.

16.570 Solar Cells - Design, Technology and Applications

Economy of solar cell energy conversion, electrical and optical properties of semiconductors, operation of pn junction, design of solar cells and solar cell manu-

facturing. Solar cells for individual customers, utility networks, the military and space. Mid term design project and laboratory measurements required.

16.571 Radar Systems

Introduction to both pulsed and C. W. radar systems. Detection of radar echoes in noise. The radar equation and its use in estimating performance of a radar system. Estimation of range, direction and velocity of targets. Moving target indicators (MTI). Pulse compression and other advanced techniques. Discussion of elements of practical radar systems. Prerequisite: 16.461.

16.574 Advanced Logic Design

Error detection and correction codes. Minimization of switching functions by Quine-McCluskey (tabular) methods. Minimization of multiple-output circuits. Reed-Muller polynomials and exclusive-OR circuits. Transient analysis of hazards. Hazard-free design. Special properties of switching algebra. Programmable logic devices. Analysis and synthesis of fundamental-mode and pulsed-mode sequential circuits. Test sets and design for testability. Prerequisites: 16.217, 16.265.

16.582 Wireless Communications

Cellular systems and design principles, co-channel and adjacent channel interference, mobile radio propagation and determination of large scale path loss, propagation mechanisms like reflection, diffraction and scattering, outdoor propagation models, Okumura and Hata models, small scale fading and multipath, Doppler shift and effects, statistical models for multipath, digital modulation techniques QPSK, DPSK, GMSK, multiple access techniques, TDMA, FDMA, CDMA, spread spectrum techniques, frequency hopped systems, wireless systems and worldwide standards.

16.584 Probability and Random Processes

Sample space, Field and Probability Measure. Axiomatic definition of Probability. Bayes' theorem. Repeated trials. Continuous and discrete random variables and their probability distribution and density functions. Functions of random variables and their distribution and density functions. Expectation, variance and higher order moments. Characteristic and generating functions. Vector formulation of random variables and their parameters.

Mean square estimation and orthogonality principle. Criteria for estimators.

Introduction to random processes: distribution and density functions; Ensemble and time averages; correlation functions and spectral densities. Classification of random processes. Random processes through linear systems. Weiner filters and Kalman filters. Co-requisite: 16.509 Prerequisite: 16.362.

16.590 Fiber Optic Communications and Networks

Optical fiber; waveguide modes, multi-mode vs single mode; bandwidth and data rates; fiber losses; splices, couplers, connectors, taps and gratings; optical transmitters; optical receivers; high speed optoelectronic devices; optical link design; broadband switching; single wavelength systems (FDDI, SONET, ATM); coherent transmission; wavelength division multiplexing and CDMA; fiber amplifiers. Prerequisites: 16.360, 16.362 or permission of instructor.

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Department of Mechanical Engineering

Struan R. Robertson, Chairperson

Professors: Majid Charmchi, John Duffy, William Kyros, John McKelliget, Alan Mironer, Eugene E. Niemi, Jr., John C. O'Callahan, Robert Parkin, Sammy Shina

Associate Professors: Julie Chen, James A. Sherwood, David Smith, Yakov Zilberberg

Mechanical Engineering Program

There are three primary components to the mechanical engineering program. The first is comprised of the mathematical, physical, and engineering sciences. These form the bedrock upon which the program is built and, which provide the necessary basis for lifelong learning and adaptation in a changing technologically based society. The second is comprised of the application of these principals and modern computer aided design tools to the design, testing, and manufacture of products, systems, devices, etc. These change continually not only because of advances in software and hardware, but because of the changing emphasis of the marketplace. For example, there is more emphasis on manufacturing and commercialization and less emphasis on defense than there was only a few years ago. The third component is comprised of the humanities and social sciences that are so necessary for students to continue their growth as citizens and as professionals in a global economy. These subjects enhance the student's ability to communicate with and understand a diversity of individuals both on and off the job.

Mechanical Engineering offers a broad spectrum of career choices. Mechanical engineers can be found in every sector of our technologically complex society. There are jobs in manufacturing, power generation, material processing, ship

building, aircraft, automotive, and construction companies; as well as with government organizations and consulting firms, to name a few. Opportunities are available in the design of machinery, product design, plant design, system integration, testing, analysis, research and development. In addition to these traditional activities, mechanical engineers are deeply involved in problems of the future such as the development of new power systems, advanced composite materials, and new methods of productivity and quality enhancement in manufacturing. In view of this broadness, mechanical engineers as the general practitioners of the engineering profession have the flexibility to move into a wide variety of fields. The mechanical engineering program is structured to offer this flexibility.

The curriculum is designed to graduate engineers who can apply fundamental principles of Mechanical Engineering with competence and sensitivity to meeting the needs of society and to continue a lifelong process of learning and growth in the profession. To achieve these goals, the program begins with a heavy concentration in mathematics, physics and chemistry. These courses form the foundation upon which the engineering curriculum is built. In addition the student is introduced to computational tools and to basic engineering practice. Subsequently, there is an emphasis on engineering science and design courses where the principles of mathematics, physics, and chemistry are applied and expanded upon in the context of engineering analysis, design, and practice. Students are exposed to experimental methods for testing and evaluation of materials, thermal/fluid processes, and equipment. The senior year offers an introduction to the multiplicity of technical areas with which mechanical engineers are concerned. Through technical electives and the capstone design experience the student can explore various specialties according to their interest.

A unique feature of the program is the dispersion throughout the curriculum of the design-build-test process. Relatively simple team projects are executed in the freshman year. The complexity of the

designs, the use of analytical tools, the fabrication methods, and testing techniques required, increase with each subsequent year. Students learn, hands-on, about different manufacturing techniques, about design methodologies, testing techniques, teamwork, and how to communicate their designs and work. Additionally they learn the importance and the place of applying the principals of the engineering sciences in accomplishing successful designs.

Students take a number of courses in the humanities and social sciences. A considerable choice of subjects is allowed. These subjects broaden the student's outlook and serve to focus attention on the importance of nontechnical knowledge in being successful professionally and as a person.

The program is accredited by the Accreditation Board for Engineering and Technology (ABET), which sets the standards for all engineering programs in the U. S. A.

Five Year BS/MS in Mechanical Engineering Program

The BS/MS program makes it possible for qualified students to attain both degrees in five years. The first three years of course work is the same as that required for students in the four year BS program. Two of the technical electives taken in the senior year are double counted, provided the grade is B or better. This reduces the number of credits for the MS degree by 6. In addition, students accepted into the program do not have to take the Graduate Record Exam (GRE). Students with a GPA of 3.00 or better may enroll in this program at the end of their junior year. At the end of the senior year the BS degree is conferred. With a further year of full time study the MS degree can be completed. Students may choose to take longer to complete the program.

Course of Study for Mechanical Engineering **

General Requirements

Freshman Year

Fall Semester

25.107	Intro to Engineering I	2
42.101	College Writing I	3
—	Gen Ed Elective	3
92.131	Calculus I	4
95.141	Physics I (mechanics)	3
96.141	Physics I Lab	1
		16

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.132	Calculus II	4
95.245	Physical Properties of Matter	3
96.245	Physics Properties of Matter Lab	1
		17

Sophomore Year

Fall Semester

22.201	Mech Des Lab I CAD	2
22.211	Statics	3
22.296	Mech of Behav Mat'ls	3
22.253	Mat Lab	1
92.231	Calculus III	4
—	Gen Ed Elective	3
		16

Spring Semester

22.202	Mech Des Lab II	2
22.212	Mechanics of Mat'ls	3
22.213	Dynamics	3
22.254	Electro-Mechanics	3
92.236	Eng Differential Eqs	3
—	Gen Ed Elective	3
		17

Junior Year

Fall Semester

22.242	Thermodynamics	3
22.311	Appl Str of Mat'ls	3
22.321	Design of Machines I	3
22.361	Appl Anal Meths/ME's	3
45.334,335	Gen Ed	
	or 341 - Ethics	3
		15

Spring Semester

22.302	ME Lab I (Instrum)	3
22.322	Design of Machines II	3
22.341	Cond & Rad Heat Tr	3
22.381	Fluid Mechanics	3
49.201/202	Economics I (II)	3
		15

Senior Year

Fall Semester

22.342	Convective Processes	3
22.403	ME Lab II: Applications	3
22.425	Des of Machine Elem	3
22.451	Dynamic Systems	3
22.473*	Des Th and Constraint	3
22.—	ME Technical Elective	3
		18

Spring Semester

22.423*	Capstone Design I or	(3)
22.424*	Capstone Design II	6
22.441	Anal of Ther/FI Proc	3
22.—	ME Technical Elective	(3)
—	HS Elective	3
—	HS Elective	3
		15
	Total Credits:	129

* Students taking Capstone I must take 22.473. Students taking Capstone II can substitute a technical elective for 22.473 and take only one technical elective in the spring.

****Note** that the curriculum evolves in time and that this represents the program at the time the catalog went to press.

Mechanical Engineering Courses (Prefix: 22)

22.201 Mechanical Design Laboratory I

Course emphasis is on introducing the use of computer aided design tools in the engineering problem solving process.

Assigned design projects require the use of both wire frame and solid modeling tools. Lecture and lab activities are used to support project requirements, and to provide more in-depth understanding of computer aided engineering design and drawing. Prerequisite: 25.108. (2 cr hrs)

22.202 Mechanical Design Laboratory II

This is an introductory course in manufacturing processes covering the basic machine tool practices utilized in the manufacturing of a product. The objective of the course is to develop broad understandings of manufacturing operations and their relationship to engineering product design. Students take the design drawings from 22.201 and fabricate the mechanical assembly using lathes, milling machines, drill presses and other conventional processes. They are introduced to metrology to determine the accuracy of the parts. Prerequisite: 22.201. (2)

22.211 Statics

The application of Newton's Laws to engineering problems in statics. The free-body diagram method is emphasized. Topics include vector algebra, force, moment of force, couples, static equilibrium of rigid bodies, trusses, friction, properties of areas, shear and moment diagrams, flexible cables, screws, bearings, and belts. Prerequisites: 92.132, 95.141. (3)

22.212 Mechanics of Materials

Topics covered include stress and deformation analysis of bodies subjected to axial, torsional, flexural and combined loading. Buckling, and unsymmetric beam sections are studied. Prerequisites: 22.211. (3)

22.213 Dynamics

Vector development of kinematics of a particle with respect to rotating and non-

rotating frames of reference in one, two, and three dimensions. The dynamics of a particle, system of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum. Prerequisites: 22.211, 22.211. (3)

22.242 Thermodynamics

A detailed development of the first and second laws as applied to open and closed systems in steady flow. Concepts of work, heat, and energy. Thermodynamic properties of pure substances, condensable vapors, and the perfect gas. The concept of entropy, reversibility and irreversibility. Power cycles. Vapor and air standard cycles. Prerequisites: 92.132, 95.245. (3)

22.253 MatLab

Application of MatLab to mechanical engineering. Topics include, programming, developing m-files and functions, use of graphical tools, matrix manipulation, and use of implicit functions. 25.106. (1)

22.254 Electro-Mechanics

Electric circuit elements such as capacitors, resistors, and inductors are studied in the context of circuit theory. Circuit equations are developed using Kirchhoffs laws. Active elements such as transistors, motors, and generators are studied. The conversion of electrical energy to mechanical energy is discussed. The behavior of electric circuits and elements are studied experimentally using various types of instrumentation. 92.132. (3)

22.296 Mechanical Behavior of Materials

The behavior of engineering materials is studied experimentally to develop an understanding of those properties that are of importance in engineering design and their phenomenological descriptions. Topics include stress, strain, strength, stiffness, thermal expansion, hardness, tensile and bending tests, strain gages, abrasion and wear, corrosion; microstructure of metals, polymers, ceramics and composites; processing, and material selection. Prerequisites: 95.245 or 84.121. (3)

22.302 Mechanical Engineering Laboratory I: Instrumentation

Students set-up and conduct specific experiments designed to study: 1) fundamental ME instrumentation systems; 2) fundamental experimental techniques; 3)

basic physical principles of mechanical systems; and 4) the application of statistical methods. Experiments are divided into two areas; solid-mechanical and thermofluids. Students develop models for use in validating and comparing with experimental results. Written communication techniques are emphasized. Prerequisites: 22.212, 22.254, 22.381. (3)

22.311 Applied Strength of Materials

The principles of strength of materials are applied to the analysis of stress in machines. The effects of combined bending, torsion, and axial loading are studied together with the effects of stress risers due to geometrical complexities. Topics include: 3-D stress transformations, principal stresses, Mohr's circles, Coulomb-Mohr and Von Mises failure criteria, and stress concentration factors. Failure under steady and fluctuating loading is studied both deterministically and statistically. Concepts from fracture mechanics are introduced. Prerequisites: 22.212, 22.296. (3)

22.321 Design of Machines I

This course concentrates on the design and kinematic analysis of linkages. The major project is a team effort, which involves the design; creation of shop-quality drawings; simulation; position, velocity and acceleration analyses; manufacture and testing of a three-position double-dwell linkage. Commercial CAD and simulation software are used. Corequisite: 22.201, Prerequisite: 22.213. (3)

22.322 Design of Machines II

This course is a continuation of 22.321 and concentrates on cam design, gear design, and power train design. The major term project involves the design, analysis, manufacture, and dynamic testing of a cam having specified characteristics. The lab uses a computer aided design tools (CAD) and computer aided manufacturing tools (CAM) to generate tool paths. Numerically controlled milling machines, and dynamic simulation codes are applied. The lab provides an opportunity for students to work together on their term project. Corequisite: 22.202, Prerequisites: 22.295, 22.321. (3)

22.341 Conduction and Radiation Heat Transfer

The theory steady and transient heat conduction in solids is developed and applied.

The principals of thermal radiation with application to heat exchange between black and non-black body surfaces, and the use of radiation networks are studied. Biot and Fourier numbers are introduced. Design projects that utilize heat transfer codes are integrated into the course. Prerequisites: 22.242, 92.236. (3)

22.342 Convective Processes

Internal and external flows, Reynold's number, laminar and turbulent flows are studied. Mathematical development of the hydrodynamic boundary layer, boundary layer separation and fluid dynamic drag are covered. Forced and free convective heat transfer, the thermal boundary layer, Reynolds's analogy, Prandtl and Grashof numbers are studied. Empirical engineering convection relations are developed. The design of heat exchangers is covered. Students engage in design projects throughout the term. Prerequisites: 22.341, 22.381. (3)

22.354 Dynamic Systems

Dynamic modeling of lumped parameter mechanical, hydraulic and thermal and electrical systems. Application of ordinary differential equations, Laplace transforms, and numerical simulation to the response of systems to forcing functions and initial conditions. Energy storage, power dissipation, and work are used to obtain equivalent systems. Nonlinear systems are linearized for small perturbations about a system operating point. Prerequisites: 22.213, 92.234, 16.211. (3)

22.361 Mathematical Methods for Mechanical Engineers

Mathematical methods applied in engineering science context. Vector differential operators. Vector integration theorems. Derivation of partial differential equations of engineering science. The method of separation of variables, eigenfunctions, eigen-values. Fourier series and integrals. Prerequisites: 92.231, 92.236. (3)

22.381 Fluid Mechanics

Development of basic fluid mechanical relations: continuity, momentum and Bernoulli equations. Emphasis is placed on the control volume approach to problem solving. Design projects are integrated into the course. Prerequisites: 22.212, 22.242, 92.231, 92.236. (3)

22.403 Mechanical Engineering Laboratory II: Measurement Engineering.

Continuation of Mechanical Engineering Lab I. Focuses on digital data acquisition systems used on mechanical engineering equipment. Students design measurement systems composed of various transducers, their associated signal conditioners and digital data acquisition and recording devices. Statistical methods are emphasized. Experiments require the students to provide calibration and to select appropriate sampling rates and test durations. Systems under test range from simple multisensor laboratory apparatus to actual operating mechanical systems. Prerequisites: 22.302, 22.311, 22.341, 22.381. (3)

22.423 Capstone Design I

Students perform independent design work and participate in team efforts to develop conceptual designs from functional requirements. Perform design analysis and synthesis, modeling, fabrication, testing, cost estimating, and documenting the essential elements of the system design. Prerequisites: 22.311, 22.322, 22.342, 22.451, 22.473. (3)

22.424 Capstone II

The objective of this two-course sequence is to expose the student to basics of engineering-design practices and procedures in the field of mechanical engineering. Students perform independent design work and participate in team efforts to develop conceptual designs from functional requirements. Perform design analysis and synthesis, modeling, fabrication, testing, cost estimating, and documenting the essential elements of the system design. Prerequisites: 22.311, 22.322, 22.342, 22.451. (6)

22.425 Design of Machine Elements

The principles of mechanics and commonly used failure theories are applied to the design and analysis of machine elements subjected to various load conditions. Elements studied include power screws, bolts, springs, bearings, gears, lubrication, shafts, brakes, clutches, and belts. Prerequisite: 22.202, 22.311. (3)

22.441 Analysis of Thermo-Fluid Processes

Dimensional analysis; similitude and modeling. Mixtures of ideal gases; air-water

vapor mixtures with application to air conditioning. Thermodynamic analysis of power and refrigeration cycles. Flow of a compressible fluid through a variable area passage; Mach number, choking, normal shock. Prerequisite: 22.242, 22.381. (3)

22.443 Cooling of Electronic Components

The methods of conduction, convection, boiling, and radiation heat transfer are applied to the cooling of electronic components. Analysis of complex heat sink arrays. Approximate methods and thermal circuit analogues are emphasized. Dimensionless heat transfer moduli. Matching of fan performance to air flow requirements. Heat pipes and cold plates. Prerequisite: 22.342. (3)

22.449 Design of HVAC Systems

Fundamentals of HVAC design: Evaluation of design conditions; heating and cooling loads calculations; psychometric analysis; equipment selection (cooling/dehumidifying coils, fans, refrigeration systems). Complete design of an air conditioning system for a typical single family residence in New England. Development of required specifications, drawings, and cost estimates. Prerequisite: 22.242. (3)

22.451 Dynamic Systems

Dynamic modeling of lumped parameter mechanical, hydraulic and thermal and electrical systems. Application of ordinary differential equations, Laplace transforms, and numerical simulation to the response of systems to forcing functions and initial conditions. Energy storage, power dissipation, and work are used to obtain equivalent systems. Nonlinear systems are linearized for small perturbations about a system operating point. Prerequisites: 22.213, 92.236, 22.254. (3)

22.453 Mechatronics

Devices and methods to monitor and control mechanical systems, with particular emphasis on the use of embedded microprocessors. Prerequisite: 22.361. (3)

22.454 Control System Engineering

Develop ability to model, analyze, and design integrated, multi-disciplinary feedback control systems. Use of root locus and frequency response compensation techniques, along with computer aided engineering tools, to meet steady state and dynamic specifications. Modeling and design of a robot arm control system is

completed and evaluated on an actual robot system. Prerequisite: 22.354. (3)

22.457 Vibrations

Fundamentals of vibration analysis of 1, 2 and multi DOF mechanical systems including the effects of damping; free response, forced response to transient and steady state harmonic and periodic excitations; the significance of natural modes, resonance frequency, mode shape, and orthogonality; vibration control, vibration isolators and absorbers; introduction to vibration measurement. Computer problems include the design of vibration control devices. A measurement project involves the use of an accelerometer, signal conditioning and analysis instrumentation. Prerequisites: 22.213, 22.361. (3)

22.473 Design Theory and Constraints

Concepts of world class design and manufacturing of modern products, including the issues of Design for Quality (DFQ), cost and the customer will be studied. Tools and techniques to be studied include Total Quality Management (TQM), statistical process control, process capability studies, six sigma quality, design efficiency ratings, design for cost, design of experiments, Analysis of Variance (ANOVA) of the mean and signal-to-noise ratio, and quality function deployment. Industrial case studies are used and student project work is required. Prerequisites: 22.202, 22.302, 22.322. (3)

22.479 Robotics

A design oriented introduction to robotics. Topics to include kinematics, inverse kinematics, static force analysis, dynamics of motion, trajectory control, optical control, vision. A student project is required. Prerequisite: 22.361. (3)

22.481 Fluid Mechanics II

Laminar and viscous flows, hydrodynamic lubrication, Navier-Stokes equations. Introduction to turbulence, Reynolds's stresses, eddy viscosity, Prandtl's mixing-length theory. Open-channel flow, hydraulic jump, uniform and non-uniform flow. Prerequisite: 22.342, 22.381. (3)

22.483 Aerodynamics and Flight Mechanics

Fundamentals of subsonic aerodynamics. Atmosphere models. Air speed measurement, boundary layers, aerodynamic heating. Circulation, downwash, and three-dimensional wing theory. Airfoil data, and

lift and drag of aircraft components. Power required and power available. Introduction to aircraft performance calculations. Prerequisite: 22.381. (3)

22.484 Jet Propulsion and Turbomachinery

Air breathing jet propulsion. Thrust, propulsion efficiency. Thermodynamics of Brayton cycle, component efficiencies, thermal efficiency. Comparison of turbo-prop, turbojet, and turbofan engines. Detailed performance calculation of turbofan engine using measured data and high temperature gas properties. Turbomachinery, velocity triangles, Euler's turbomachinery equation. Axial flow compressor, rotating stall and surge stability compressor map. Axial flow turbines, exhaust nozzles, afterburners. Engine component matching. Future trends in jet propulsion. Corequisite: 22.441, Prerequisite: 22.442, 22.381. (3)

22.499 Directed Studies in Mechanical Engineering

This course provides seniors in Mechanical Engineering with the opportunity to pursue the study of a technical topic or project, individually under the supervision of a faculty member and, if desired, a responsible project engineer from industry. The course is to result in a term paper or technical report. Prerequisite: permission of instructor. (3)

Graduate Courses

500 level graduate courses may be taken as technical electives, with prior approval, by seniors with at least a 3.00 GPA.

22.512 Applied Finite Element Analysis

An introduction into finite element methods using popular commercial packages. The features common to different programs as well as special features of particular programs are presented. Primary focus is on hands-on familiarity of the software with a limited discussion of the underlying finite element theory. ALGOR, ADINA, ABAQUS, LS-DYNA3D, ANSYS, HyperMesh, FEMAP, and SDRG-IDEAS are among the pre/postprocessing and analysis packages used in the survey. (3)

22.513 Finite Element Methods

Matrix algebra and the Rayleigh-Ritz technique are applied to the development of

the finite element method. The minimum potential energy theorem, calculus of variations, Galerkin's and the direct-stiffness method are used. Restraint and constraint conditions are covered. C0 and C1 continuous shape functions are developed for bar, beam, and two and three dimensional solid elements. Recovery methods, convergence and modeling techniques are studied. Applications to problems in static stress analysis and heat conduction. (3)

22.515 Modal Analysis I - Theoretical

Review of single and multiple degree of freedom systems using classical and Laplace formulations. Finite element methods for dynamic systems. Model reduction/expansion formulations. Modal participation and mode activation concepts. Linear algebra review, matrix formulations, matrix eigenanalysis, generalized inverses, spectral and singular valued decomposition techniques. Fourier transformations. Models developed using MAT_SAP and MATLAB. (3)

22.527 Solar systems Engineering

Systems engineering, stochastic modeling, design, and life-cycle cost analysis of several solar systems: photovoltaics, passive heating, solar cooling, and daylighting. (3)

22.531 Advanced Mathematics for Mechanical Engineers

Analytical and numerical solution of ordinary and partial differential equations that are applicable to mechanical engineering. Included in the topics covered are; review of solution techniques for linear O.D.E.'s with constant coefficients, trajectories, Picard iteration, Newton-Raphson, Gauss-Seidel, Runge-Kutta, systems of O.D.E.s, Legendre and Bessel functions, generalized Fourier series, boundary and initial value problems, separation of variables, and finite difference techniques. Membrane, wave propagation, and heat conduction problems are analyzed. (3)

22.534 Applied Numerical Methods

Number systems and error. Gaussian methods of linear algebra. Matrix eigenvalues. Difference and summation calculus. Interpolation. Definite integrals. Differential equation modeling and stability. Orthogonal polynomials. Roots of polynomials. Zeroes of single variable functions. Optimization. (3)

22.543 Convective Heat and Mass Transfer

Conservation equations. Heat transfer in laminar and turbulent boundary layer and duct flow. Free convection. Convective mass transfer. (3)

22.544 Conductive and Radiative Heat Transfer

Steady and unsteady state heat conduction: analytical solutions. Radiative heat transfer between surfaces and participating media. (3)

22.547 Numerical Methods in Thermo-Fluid Systems

Fundamentals of finite difference schemes: stability, consistency and accuracy. Application of state-of-the-art numerical methods to the solution of problems involving fluid flow, heat transfer, chemical reactions and turbulence. (3)

22.550 Advanced Vibrations

Modeling and solution of multi-degree of freedom problems. Matrix methods are used along with an applications program. Shock spectrum methods and non-linear effects are considered. (3)

22.551 Advanced Dynamics

Formulation of advanced representations of kinematics and dynamics. Development of Lagrangian and Hamiltonian dynamic equations. Dynamics of systems with constrained motion. Principal of virtual work. Gyroscopic effects. Introduction to non-holonomic systems. (3)

22.554 Dynamic Systems and Control

Matrix-based classical and modern techniques are applied to the dynamics of control systems. Design of controllers, and full and reduced-order observers. Introduction to optimal control and Kalman filters. (3)

22.562 Solid Mechanics

Topics covered include the theory of stress, kinematics of strain, Hooke's Law, work and energy, equations of stress equilibrium, Navier's equations, strain compatibility, and the Beltrami-Michell equations. Problems for uniformly varying 3-D states of stress, torsion, plane and axisymmetric deformation are studied. . Prerequisite: 22.531. (3)

22.571 Concurrent Engineering and Quality

Focuses on methodologies used by world

class companies to guide the design and development of high quality, low cost products in the most timely manner through the use of analytical tools in case studies: Topics include: new product creation strategy and process, organizational aspects of multi-disciplinary design teams, concurrent project management, and structural methodologies for identifying customer requirements and manufacturing process design, control and selection. In particular, focus is on the interrelationship of CE, manufacturing and Quality tools and methodologies and how they contribute in determining the appropriate level of product/process quality and design efficiency. (3)

22.573 Manufacturing Systems

The design and evaluation of manufacturing systems: stochastic process models, discrete and continuous Markov chains, queueing theory, optimization, and linear and integer programming. (3)

22.575 Industrial Design of Experiments

Concepts of Robust Design and statistical Design Of Experiments (DOE) as applied to the design and manufacturing of new high technology products. Classical and current methodologies of DOE including Full Factorial, Fractional Factorial, Taguchi, Central Composite and Yates Algorithms. The course will also provide for different methods for experimental design and analysis, including average and variability analysis. Commercial software packages and case studies using industrial experiments will be used to illustrate the material. (3)

22.577 Event Driven Manufacturing

This course develops and applies the tools to analyze, predict and control production flow under diverse product manufacturing conditions. Topics covered include, group technology, the Li/Parkin sorting algorithm, multi-dimensional category sorting, time-driven simulation systems, event-driven simulation, product assembly templates, production simulation and scheduling, bottleneck identification, and hierarchical system interrogation.

22.579 Robotics

Common robotics joints and robotics classification. Planes of motion and fold lines. Robotics capability. Forward and inverse kinematics and the RobSim software pack-

age. Trajectory planning and elementary obstacle avoidance. Robotics dynamics and feasible trajectory evaluation. Design of the control system for the non-linear robotics problem. Classroom studies are followed by hands-on applications in the Automated Manufacturing Assembly and Robotics Laboratory. (3)

22.581 Advanced Fluid Mechanics

Fundamental equations of fluid motion, kinematics, vorticity, circulation, Crocco's theorem, Kelvin's theorem, Helmholtz's velocity laws, secondary flows. Stream function, velocity potential, potential flows. Unsteady Bernoulli equation, gravity water waves. (3)

22.582 Viscous Flow

Derivation of Navier-Stokes equations. Examples of exact solutions. Laminar and turbulent boundary layer. Low Reynolds number flow. (3)

22.589 Finite Element Method in Thermal/Fluids

Galerkin techniques are used to derive the finite element equations for viscous and nonviscous flows, and heat conduction. Isoparametric elements are studied. Application to laminar and low speed turbulent flows and to problems in heat conduction are made. (3)

22.591 Mechanical Behavior of Materials

Quantification of structure-property relationships requires application of solid mechanics concepts to materials micro-structure. Using micro-mechanics approach, the course focuses on the deformation and fracture behavior of metals, ceramics, composites and polymers. Topics include: elastic behavior, dislocations, crystal plasticity, strengthening mechanisms, composite materials, glassy materials, creep and creep fracture, tensile fracture, and fatigue. (3)

22.593 Failure Analysis

The prediction, analysis, and prevention of failure in mechanical design is covered. Failure mechanisms such as creep, plastic deformation, crack propagation, cyclic fatigue, thermal fatigue, fretting and galling are considered. Theories of failure such as Colomb-Mohr, Beltrami, and Huber-Von Mises are used to predict failure. Cumulative damage theories such as those of Gatts, Corten and Dolan, Marin, and Manson will be studied. Statistical

methods of analysis and test data interpretation are studied. Materials such as steels, aluminum alloys, solders, plastics, and composites will be considered. (3)

22.596 Composite Materials

Analysis of anisotropic lamina and laminated composites. Methods of fabrication and testing of composites. Other topics include environmental effects, joining and machining. (3)

Mechanical Engineering Advisory Board

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Plastics Engineering Program

Robert E. Nunn, Chairperson

Stephen Orroth, Executive Officer

Professors: Aldo Crugnola, Rudolph Deanin, Stephen Driscoll, Steven Grossman, Jan-Chan Huang, Francis Lai, Robert Malloy, Stephen McCarthy, Robert Nunn, Stephen Orroth, Stephen Petrie, Nick Schott, Amad Tayebi

Associate Professor: Ross Stacer

Assistant Professor: Carol Barry

This program is designed to prepare the graduate for a professional career in the polymer industries of which plastics is the largest. Other segments include rubber, coatings, and adhesives. The curriculum provides a sound basis in mathematics, chemistry and process engineering, plus a full study of plastics materials, properties, physics, engineering sciences, and product design. It includes sufficient flexibility for further specialization in areas of individual interest. Undergraduates may join the nation's first student chapter of the Society of Plastics Engineers (SPE). Other Engineering societies that are relevant are SAMPE and SAE.

Since the program started in 1954, more than 2000 graduates have been employed by polymer industries throughout the United States, Europe, and Asia. Major plastics producers and users recruit annually on campus. While most job openings are in manufacturing, product and process development, or in technical service and marketing, some graduates go into research, consulting, and teaching. The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Program Educational Objectives

The primary objective of the Plastics Engineering Program is to provide a well-rounded basic level engineering education that prepares our graduates to be readily employable professionals in a lifetime career of plastics engineering.

The curriculum provides a sound foundation in basic sciences, engineering disciplines and communication skills plus a detailed study, including a laboratory experience, of plastics materials, properties, processing and design. The curriculum aims to foster professionalism, ethics and safety.

Graduates shall be well qualified to pursue advanced studies leading to careers in research, manufacturing or teaching.

The department shall maintain the highest standard of academic excellence in Plastics Engineering, and maintain a caring environment for students of diverse backgrounds.

Course of Study for Plastics Engineering

Freshman Year Fall Semester

25.107	Intro to Engineering I	2
42.101	College Writing I	3
84.121	Chemistry I*	3
84.123	Chemistry Lab I	1
92.131	Calculus I*	4
95.141	Physics I*	3
96.141	Fund Exp Physics I	1
		17

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.122	Chemistry II*	3
84.124	Chemistry Lab II	1
92.132	Calculus II*	4
95.144	Physics II	3
96.144	Fund Exp Physics II	1
		17

*Appropriate honors courses may be substituted for qualified students.

Sophomore Year Fall Semester

22.211	Eng Mechanics	3
26.001	Pl Safety Lecture	0

26.201	Poly Materials I	3
26.215	PI Proc Lab I	1
84.203	Applied Org Chem	3
84.205	App. Org Chem Lab	1
92.231	Calculus III	4
		15

Spring Semester

26.002	PI Safety Lecture	0
26.202	Poly Materials II	3
26.212	Dyn. of Mot. Gen. Sys.	1
26.216	Plastics Proc Lab II	1
26.218	Intro to PI Design	2
26.247	Thermodynamics	3
92.234	Differential Equations	3
—	Aesthetics (AE)	3
		16

Junior Year**Fall Semester**

26.001	PI Safety Lecture	0
26.301	Poly Materials III	3
26.314	Fluid Flow	3
26.315	PI Process Lab III	1
26.377	PI Proc Eng I	3
49.201	Economics	3
—	Historical Studies	3
		16

Spring Semester

26.002	PI Safety Lecture	0
26.306	Exp. Analysis	3
26.316	PI Proc Lab IV	1
26.348	Heat Transfer	3
26.373	Pl. Mold Eng.	3
26.378	PI Proc Eng II	3
84.339	Phys Chem Prin	2
84.341	Phys Chem Lab	1
		16

Senior Year**Fall Semester**

26.001	PI Safety Lecture	0
26.403	Phy Prop Poly	3
26.404	Process Control Sys.	3

26.415	Phys Prop Lab I	1
84.403	Int Poly Sci I	3
84.405	Polymer Lab I	1
—	BS,BA,BSV Elective	3
—	Tech Elective**	3
		17

Spring Semester

26.002	PI Safety Lecture	0
26.406	Polymer Structures	3
26.416	Phys Prop Lab II	1
26.418	Prod. Proc. Design	3
—	Literature Elective (LT)	3
—	Values Elective (VC)	3
	Technical Elective**	3

Total credits: 130

**Students registered for Co-op program may, with the prior approval of the Department's Co-op Advisor, take 25.491/2/3 (Industrial Experience) to satisfy the Technical Elective requirements.

Combined B.S. /M.S. Engineering**Degree Program in Plastics**

The Plastics Engineering Department offers a program of accelerated study in order to encourage outstanding (GPA 3.0) undergraduate students to continue their studies toward an advanced degree in plastics and other polymer applications. Interested students should file a Graduate School application in the junior year. Applicants for this program are not required to take the Graduate Record Examination.

Upon recommendation of the student's advisor, and with the approval of the department graduate admissions committee and the Dean of the Graduate School, the student may be admitted to graduate study during the second semester of the senior year as a provisional graduate student.

The student will receive a Bachelor's degree at the end of the fourth year of study, if all course requirements have been met. Acceptance as a matriculated gradu-

ate student is contingent upon the further recommendation of the department committee and the approval of the Dean of the Graduate School. Up to eight credit(s) of the B.S. degree may be applied to the Graduate Program.

Fall Semester

A graduate course in Plastics Engineering may be taken in place of an undesignated elective (three credits). Students may take a graduate seminar (one credit).

Spring Semester

A graduate course in Plastics Engineering may be taken in place of an undesignated elective (three credits). Students may take a graduate seminar (one credit).

In some cases, an undergraduate student may take additional graduate courses, credits for which are not applied to the minimum University requirements for the Bachelor of Science in Engineering, and apply these to the Master of Science in Engineering. However, no student may transfer more than 12 credits into the Graduate Program.

During the summer preceding the fifth year, the student, if accepted as a matriculated student in the Graduate School, will begin his or her thesis research. By the end of the fifth year the student may expect to have completed 16 credits of graduate electives and six credits of thesis research, in addition to the credits taken in the senior year which are applicable to the master's degree program.

Students taking full advantage of the combined program ordinarily may expect to finish the M.S. Engineering degree at the end of the fifth year of study. Actual completion will depend upon the student's course load and thesis work.

A student may be eligible for financial assistance, i.e., fellowships and teaching assistantships, during the fifth year of study, but acceptance of such assistance and the attendant responsibilities may delay the completion of the program beyond the period specified in the preceding paragraph.

Plastics Engineering (Course Prefix: 26)

26.201/202/301 Polymeric Materials I and II

This three semester sequence details the chemistry, properties, processing and design characteristics of both thermosetting and thermoplastic polymers. The structure/property relationships of amorphous and semi-crystalline polymers will be reviewed. Representative end-use applications of commodity, engineering, and specialty plastics will be discussed, along with updated comments on contemporary industry-related problems, including feedstock availability and alternatives, regulatory affairs, and environmental issues. (3,0)3

26.212 Dynamics of Motion Generation Systems

Cam-generated motion, including design of cams and dynamics of cam follower. Multibar mechanisms including analysis of their displacement, velocity and acceleration. (1,0)1

26.215 Plastics Process Engineering Laboratory

A laboratory course to study polymer processing methods. Experiments are designed so that the student will understand the theory of polymer conversion techniques by the interaction between process variables and materials. Some of the conversion methods studied are extrusion, injection molding, rotomolding, thermoforming, compounding and mixing. Corequisite: 26.201. (0,3)1

26.216 Plastics Process Engineering Laboratory II

Continuation of 26.215. Corequisite: 26.202. (0,3)1

26.218 Introduction to Plastics Design

Introductory course developing the fundamentals of design principles in plastics applications. Commercial design software will be used. (1,2)2

26.247 Elements of Thermodynamics

The principles of thermodynamics, a study of the first and second laws of thermodynamics with applications to classic power generation and refrigeration systems. The concepts of entropy, reversibility, irreversibility and availability. Prerequisite: 92.231. (3,0)3

26.301 Polymeric Materials III

A continuation of 26.201, 26.202. Prerequisite: 26.201 and 26.202. (3,0)3

26.306 Methods of Experimental Analysis

Basic concepts dealing with the interpretation of experimental engineering results. Deterministic vs. stochastic processes. Elementary probability theory and common distributions. Graphical analysis and mathematical modeling. Statistical parameters and their applications to quality control, and tests of significance. Design of experiments (DOE) for process development and optimization.

26.314 Fluid Flow

Statics and dynamics of Newtonian and Non-Newtonian fluids. Bernoulli equation, flow in closed conduits, measurement of fluid flow, external flow, rheology of melts, control volume, temperature and entrance effects. Applications of flow equations to plastics processing. Prerequisite: 92.231. (3,0)3

26.315 Plastics Process Engineering Laboratory III

A continuation of the processing laboratory sequence with emphasis on advanced processes and control of plastics processing. Processes include twin-screw extrusion, blow molding, and injection molding while process control examines hydraulic circuits, process control systems, transfer methods in injection molding, and process windows. Prerequisites: 26.216, 26.202. (0,3)1

26.316 Plastics Process Engineering Laboratory IV

The fourth course of the processing laboratory sequence examines experiment design and analysis of variables, statistical quality control and statistical process control. Prerequisites: 26.216, 26.202. (0,3)1

26.348 Heat Transfer

Theory and application of steady and transient heat conduction, convection, and radiation. Heat transfer in plastics processing. Analysis of heat exchangers. Prerequisites: 92.231, 92.234. (3,0)3

26.373 Plastics Mold Engineering I

Course work entails the introduction to the fundamentals of plastics mold and die engineering with the objective to develop an overall appreciation of the mold engineer's job. Emphasis is placed on an integrated approach to mold engineering

which includes the interrelationships of polymeric materials, engineering principles, processing, and plastics product design: mold and die design/construction, and design communications. Laboratory consists of the actual design of a mold or mold components with emphasis on CAD and computerized Material Databases. A semester project is required. Junior status or permission of instructor. (2,2)3

26.377 Plastics Process Engineering I

A study of the fundamental principles of polymer processing, i.e., the conversion of the polymeric materials into useful articles. Correlation between process variables, material characteristics and parts design are studied to determine the functional relationships between them. Prerequisites: 26.215, 26.216. Corequisite: 26.315. (3,0)3

26.378 Plastics Process Engineering II

A continuation of 26.377. Prerequisite: 26.377. (3,0)3

26.403 Physical Properties of Polymers

Introduction to basic mechanical properties of polymers as linear viscoelastic materials. Concepts of creep, stress relaxation, and superposition principles are emphasized. Dynamic mechanical behavior, interrelations between various properties, electrical behavior, miscellaneous mechanical properties, optical properties. Prerequisite: senior status. (3,0)3

26.404 Process Control Systems

Basic principles of control systems used with plastics processing equipment. Included are instrumentation, signal conditioning, data acquisition, feedback control, process monitoring, data reduction, SPC/SQC, and Taguchi methods. Prerequisite: 92.234 or permission of instructor. (3,0)3

26.406 Polymer Structure, Properties, and Application

The fundamental relationships between molecular structure, properties and end-use applications of plastics materials will be explored in detail. Molecular structural features include chemical composition, molecular size and flexibility, intermolecular order and bonding, and supermolecular structure. Properties include processability, mechanical, acoustic, thermal, electrical, optical and chemical properties, price, and balance of properties. Applications

include rigid solids, flexible solids, foams, film and non-plastic applications. (3,0)3

26.407 Plastics Industry Organization

Economics of producing plastics raw materials and converting them into end products, from research and development to plant construction, operation, and marketing. Market analysis of plastics production, processing, and consumer patterns; commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit and growth. Prerequisite: permission of instructor. (3,0)3

26.409 Senior Research in Plastics I

Individual research projects in plastics chemistry, properties, processing, products, and industry organization. Students will review the existing literature, obtain materials and equipment, plan and carry out research programs and submit final reports for publication. Prerequisite: permission of instructor. (0,6)3

26.410 Senior Research in Plastics II Continuation of 26.409. (0,6)3

26.413 Senior Projects I

Assignment of senior projects designed to develop the student's ability to organize and conduct investigations on material performance and processing techniques. Prerequisite: permission of instructor. (0,3)1

26.414 Senior Projects II Continuation of 26.413. (0,3)1

26.415 Physical Properties Laboratory I

Two-semester capstone laboratory. Student groups design, perform, analyze, report, and defend a research project which incorporates the processing and characterization of plastics materials. Supporting practicums on literature searches, plastics processing, basic plastics testing techniques, and data analysis are included in the course. Corequisite: 26.201. (0,3)1

26.416 Physical Properties Laboratory II

Continuation of 26.415. Corequisite: 26.202. (0,3)1

26.418 Product and Process Design

Theoretical principles and sound engineering practice involved in the design of new

end products made from polymers, applying the total systems approach to the balance between product design, choice of materials, tool design, and process techniques, as they affect competitive choices for commercial success. A semester project is required. Prerequisite: senior status or permission of instructor. (3,0)3

Primarily for Graduate Students and students in the five year BS/MS Program.

Graduate courses are open to undergraduates with permission of the instructor. Courses marked with an asterisk (*) will be offered only if there is sufficient student demand.

26.502 New Plastics Processing Techniques

Critical examination of new plastics processing techniques appearing in the research literature and being commercialized in the plastics industry. (3,0)3

26.503 Mechanical Behavior of Polymers*

Mechanical properties of bulk polymers. Linear viscoelasticity, creep, relaxation, dynamic and stress/strain response phenomena. Principles of time/temperature superposition. Rubber elasticity. Failure behavior of polymeric materials. (3,0)3

26.504 Physical Properties of Polymers*

Polymers as linear viscoelastic materials. Creep, stress relaxation, superposition, dynamic mechanical behavior, electrical behavior, miscellaneous mechanical properties, optical properties, transport properties. (3,0)3

26.505 Polymer Structure II Continuation of 26.506 (3,0)3

26.506 Polymer Structure, Properties, and Applications

Relationships between polymer structure (chemical composition, molecular weight and flexibility, intermolecular order and bonding, supermolecular structure) and practical properties (processability, mechanical, acoustic, thermal, electrical, optical, and chemical) and applications. (3,0)3

26.507 Plastics Industry Organization Economics of producing plastic raw materials and converting them into end prod-

ucts, from research and development to plant construction, manufacturing and marketing. Market analysis of plastics production, processing, and consumer patterns; commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit, and growth. (3,0)3

26.509 Plastics Processing Theory I

Principles of rheology and continuum mechanics involved in the processing of plastics, and their applications in plastics process engineering including flows in standard geometries and extrusion applications. (3,0)3

26.510 Plastics Processing Theory II

A continuation of Theory I using the transport phenomena approach to analyze and describe plastics conversion processes, including roll processing blown film extrusion, injection molding, and mixing. (3,0)3

26.511 Polymer Blends and Multiphase Systems*

Physical, mechanical, and thermal properties, preparation, and testing of polymer blends, alloys, and multiphase systems. Thermodynamic theories and experimental determination of miscibility of polymer blends. Structure property relationships for multiphase systems and interpenetrating networks. (3,0)3

26.512 Plastics Foams*

Preparation, structure, and properties of plastics foams. Practical systems in development and production. Properties, applications, and markets for plastics foams and products made from them. (3,0)3

26.513 New Plastics Materials*

Critical examination of the new plastics appearing in the research literature and being field-tested for commercialization in the plastics industry. (3,0)3

26.516 Composite Materials

The potential of composites as a class of materials, and the uniqueness of the mechanical/physical properties realizable. Fundamental concepts underlying those properties, with particular emphasis on fibrous reinforced plastics. Survey of matrices, reinforcements, and prediction of composite properties from a knowledge of the properties and topology of constituent materials. Factors affecting ultimate strength and fatigue behavior. (3,0)3

26.518 Product Design

Theoretical principles and sound engineering practice involved in the design of new end products made from polymers applying the total systems approach to the balance between product design, choice of materials, and process technique, as they affect competitive choice for commercial success. A semester project is required. (3,0)3

26.523 Plastics Process Analysis

Energy balances, energy efficiency for extrusion and injection molding, application of energy equation (conduction, convection, viscous dissipation), equations of state, melt conveying in simple and compound screws, screw scale up, plastication. (3,0)3

26.524 Process Analysis,**Instrumentation and Control***

Industrial instruments for measurement and control of plastics processes. Design of experiments. Analysis of plastics forming operations. Dynamic testing techniques. Automatic plastics process control. Data acquisition systems, SPC/SQC and Taguchi methods. (3,0)3

26.525 Processing of Synthetic Fibers and Structures*

An introduction to systems utilized in the processing of synthetic fiber structures. These include drawing, winding, texturing, staple fiber production, blending, spinning, weaving, knitting, braiding and production of non-wovens. The effect of these mechanical, and physical processes on the resultant fiber structure and behavior. (3,0)3

26.527 Mechanics of Fibrous Structures*

Characteristics of fibers as affecting performance of conventional and non-conventional fibrous structures. Design considerations and mechanical behavior of twisted, knitted, woven, braided and non-woven fibrous materials. (3,0)3

26.528 Plastics Information Seminar

Review of procedures for literature searching, data bases, etc. (1,0)1

26.530 Selected Topics: Plastics I

Topics in various fields of Plastics Engineering. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge of contemporary Plastics Engineering. (3,0)3

26.531 Design of Automated Assembly Systems

Principles of feeding, sorting and orienting components. Hydraulic, pneumatic and electric actuators. Pick and place systems. Methods of assembly of components with emphasis on product design for automated assembly. Linear and rotary assembly systems. Multi-function process and timing diagrams. Principles of programmable controllers and process design logic. (3,0)3

26.532 Adhesives and Adhesion*

Adhesive joining of engineering materials. Surface chemistry, theories of adhesion and cohesion, joint design, surface preparation, commercial adhesives, rheology, equipment, testing, service life, and reliability. (3,0)3

26.533/534 Coatings Science and Technology I and II

Polymers, pigments, solvents, and additives used in coatings. Methods of polymerization, formulation, application, and testing. Substrates and applications. (3,0)3

26.535 Rubber*

Polymerization and compounding of the commercial elastomers. Properties and test methods. Leading applications and methods of processing. (3,0)3

Rheology of Coatings*

Rheology of polymer melts, solutions, latexes, and pigment dispersions, and their application to coatings and adhesives. (3,0)3

26.537 Engineering Properties of Plastics*

Theoretical basis and practical significance of the mechanical, thermal, electrical, optical and chemical properties of plastic materials. Importance of engineering properties in material development and selection and in product design. (3,0)3

26.538 Selected Topics: Plastics II

Continuation of 26.530. (3,0)3

26.539 Selected Topics: Plastics III

Continuation of 26.530. (3,0)3

26.540 Commercial Development of Polymeric Material Systems*

The concepts of industrial marketing will be reviewed for research, pricing strategies, and product planning for market segmentation, place (distribution)-promotional activities. Topics will include creating a

demand, selling, and servicing base resins and additives. (3,0)3

26.541 Computer Applications in Plastics Processing*

This course provides a fundamental approach to computer applications for plastics processing. Emphasis is upon the fundamental principles and techniques of Pro/Engineer and SolidWork as applied to plastics processing problems, allowing students to understand the various methods used to solve the problems in designing plastics part. At the completion of the course the students are expected to be able to communicate effectively with technical personnel and engineers and to prepare the CAD database so it will be useful for analysis, manufacturing, and presentation purpose. (3,0)3

26.543/544 Survey of Plastics Materials

Descriptive course centering on the historical development of polymeric systems, their synthesis, structure, properties, and applications. Included will be a brief discussion on the typical additives employed to make plastics molding compounds. Not open to undergraduate plastics students. (3,0)3

26.545 Additives for Polymeric Material*

Additives incorporated into polymers to modify processing and end-use properties: reinforcements, plasticizers, stabilizers, flame retardants, colorants, biostats, blowing agents, anti-stats, impact modifiers, and processing aids. (3,0)3

26.546 Mixing in Plastics Processing*

Solids mixing, mixing in viscous fluids, admixing, concept and techniques of residence time distribution, continuous and batch processes, improvement of extrudate quality, scale-up and theory of similarity, dispersion and distributive mixing, mixing and heat transfer. (3,0)3

26.547 Analytical Techniques for Plastics Engineers

Vector and tensor analysis, matrices and determinants, vector differential calculus, Laplace and Fourier transforms, power series, ordinary and partial differential equations. Use of the above techniques in plastics engineering calculations. (3,0)3

26.548 Numerical Techniques for Plastics Engineers*

Use of numerical methods in the solution of problems concerning rheology, heat transfer, diffusion, and viscoelastic theory. Topics include solutions to ordinary differential equations, simultaneous linear equations, partial differential equations, finite difference methods, linear regression, linear interpolation, curve fitting and Monte Carlo techniques. (3,0)3

26.552 Design of Polymer Processing Machinery*

Hydraulics, machine logic, drives, pumps, motors, heaters, barrel and screw combinations, mechanical design. Hydraulic and electrical control circuits development. A semester project is required. (3,0)3

26.557 Composites Fabrication I

Introduction to resins and reinforcements. Fabrication of thermoset composites. Hand lay-up, vacuum bagging, autoclaving, compression molding, rheological testing. Design concepts, product management, quality control. (2,3)3

26.558 Composites Fabrication II

A continuation of 26.557 with emphasis on a semester project on design, processing, and economics of composites. (2,3)3

26.559 Elements of Packaging*

Packaging methods, materials, and container designs. Analysis of container manufacturing methods for paper, plastics, cans, cardboard, and their specific properties. (3,0)3

26.563/564 Materials Seminar I and II

Individual research and presentation in the field of Plastics Materials. (1,0)1

26.565 Engineering Polymers

A Continuation of 26.543/544 with emphasis on the engineering, high performance, and specialty polymers, including nylons, acetals, acrylics, polycarbonates, polyaryl sulfones, LCP's, polyimides, fluoropolymers, and engineering alloys/blends. Prerequisites: 26.543/544. (3,0)3

26.566 Polymeric Material Systems Selection*

This course investigates the selection processes to be followed in screening material candidates, and specifying a material of record. Emphasis is placed on prioritizing performance requirements, contrasting potential candidates, reviewing processing demands, and post-fabrica-

tion schemes. The course will be based on actual case studies. Prerequisites: 26.201/202/203 or 26.543/544/565. (3,0)3

26.567/568 Dynamic Mechanical Rheological Properties

Practical review of theoretical concepts of rheological measurements with practical applications of experimental techniques. Emphasis will be on the viscoelastic properties of polymer solutions, melts, and solids with correlation with theoretical dynamic mechanical behavior. (3,0)3

26.575 Biomaterials

An appropriate understanding of biomaterials demands a broader view of the field than study limited to the properties of the different metals, ceramics, plastics, elastomers, textiles and composite structures employed as body implants. To advance a fuller appreciation of the challenges offered, the course will include: lectures devoted to the anatomy and physiology of the human body, an introduction to the biomechanics of hard and soft tissue, lectures treating the body's response through inflammation and infection to implanted materials and devices and a case study that follows the development of an IMPLANT from its conception through a) its mechanical/material design, b) its in vitro and in vivo evaluation, c) its conformance to pertinent government regulations and d) its final adoption as a clinical procedure. Prerequisites: An engineering degree that includes a course in materials or permission of the instructor.

26.576 Advanced Mold Design

This course is a continuation of the undergraduate course 26.373. Advanced topics on materials of mold construction, advances in rapid tooling, computerized mold quoting, new developments and methods of forming, cooling, and part ejection are discussed. A more analytical treatment of the subject matter is given based on the relevant rheology, thermodynamics, heat transfer, fluid flow and strength of materials.

26.579 Problems in Biomaterials - Directed Studies

Selection of a current biomaterial problem of interest by the individual student, examination of pertinent literature to determine present knowledge in the area, formulation of an approach to resolve or clarify the issues involved, and (time per-

mitting) work towards the solution of the selected problem. Prerequisites: 26.575 or permission of the instructor.

26.580/581 Polymer Science I & II

An introductory course in polymer science and technology including basic classification and molecular structures, synthesis, solution properties and molecular weight determination, solid-state properties including both the amorphous and crystalline states, degradation mechanisms, polymer reactions, network formation, copolymerization and blends/alloys. This class is only offered in the evenings and may be used as a substitute by Plastics Engineering majors for 97.503/504. (3,0)(3,0)6

26.582/569 Design Seminar I and II

Individual research and presentation in the field of Plastics Design.

26.583 Research Methodology*

A systematic evaluation of the techniques used in efficient research and development. Experimental data are analyzed and plotted using a mathematical approach. Creative thinking, problem solving, and student presentation of data are stressed. Extensive reading of research papers, analysis of such, and defense of the analysis required. (3,0)3

26.584 Injection Molding Seminar*

Individual research and presentation in the field of Injection Molding. Primarily for students performing Thesis research in Injection Molding. May be substituted for 26.570 or 26.584. (1,0)1

26.585 Computer Aided Engineering and Design I*

This course provides a fundamental approach to computer-aided engineering for plastics processing. Emphasis is upon the theory and techniques of computer aided engineering as applied to plastics processing problems, allowing students to understand the various assumptions and methods used to create the programs. (3,0)3

26.586 Computer Aided Engineering and Design II*

Modeling and process simulation in plastics processing. Design of plastic components and molds. Use of finite element programs to perform flow, cooling, and stress analysis of injection molded parts. Prerequisites: 26.585. (3,0)3

26.590 Survey of Intellectual Property (in the Plastics Industry)

A review of patents, trademarks, copyrights and their application for protection of technology in the plastics industry. Other topics to be considered will be employee rights/non-competition agreements, foreign protection, and technology licensing. (3,0)3

Plastics Engineering Industrial Advisory Board

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Department of Work Environment

David H. Wegman, M.D., Chairperson

Professors: Ellen A. Eisen, Michael J. Ellenbecker, Robert A. Karasek, David Kriebel, Charles Levenstein, Laura Punnett, Susan R. Woskie

Associate Professors: Bryan O. Buchholz, Kenneth R. Geiser, Jr., Rafael Moure-Eraso, Margaret Quinn

The Strategic Plan of the University of Massachusetts stresses the promotion of economic productivity through technological developments while also protecting and promoting health in the work environment. To achieve this goal the University is working to become the region's principal resource for the provision of scientific and policy guidance in the identification and amelioration of health and safety hazards in industrial and service sector workplaces. The Department of Work Environment is the center for this effort and has already become a key resource for New England.

Objectives of the Department of Work Environment

The Department of Work Environment takes a unique approach to the identification and prevention of health hazards in the workplace. No other university program in the U.S. is addressing these problems comprehensively in an engineering college, and no other program combines strong research efforts in occupational ergonomics, industrial hygiene, occupational epidemiology, policy analysis and clean production/pollution prevention. The Department's model of research and education integrates a strong scientific methodology and cooperative work with the region's industry and labor to solve the pressing societal problems in workplace injury and illness control. Graduate training at both the masters and doctoral level is essential to the success of this new approach. There is a serious short-

age of graduate trained professionals in industry, government and academia which the Department is training students to fill.

The goal of the graduate program is to prepare scientists with the ability to scientifically evaluate the hazards of workplace exposures as well as the effectiveness of engineering or administrative control measures. To this end the proposed program will prepare graduate professionals with the skills to conduct sophisticated investigations of problems so that the best information is available when redesigning production systems to improve their environmental and health performance. A second objective of the program is to instill a sensitivity to and respect for the complex social, political and economic context in which occupational health problems must be studied and solved.

The Department of Work Environment does not offer undergraduate degree programs. There are, however, a number of joint BS/MS degree programs existing or under development.

Graduate Program in Occupational Ergonomics:

Ergonomics provides the scientific basis for optimized design of the work environment compatible with the capabilities and limitations of the working population. An ergonomist is trained to recognize, evaluate, and control hazards in the work environment that result from a poor fit between the worker and the workplace; these hazards may result in acute injury, chronic musculoskeletal disorders, or mental/psychosocial "stress." The physical demands of machines, tools, and work methods must accommodate the range in size, strength, mobility, and endurance of the workforce. Information flow must be structured so that the worker can process and respond appropriately without being mentally overstressed to the degree that errors result. Job content and work organization should be designed to optimize skill utilization and learning, physiological and psychological well-being.

The concentration in Ergonomics is designed to develop an understanding of human anatomy, physiology, and psychology, of industrial hygiene and epidemiology as well as modern manufacturing technology and work organization. It provides a multidisciplinary background in these basic areas, as well as their application to the practical problems in ergonomics that are encountered in industrial and service work environments.

Graduate Program in Industrial Hygiene

Industrial hygiene is concerned with the protection of worker health through the prevention of occupational illness. Industrial hygienists accomplish this goal through the recognition, evaluation, and control of chemical, physical, and ergonomic hazards in the work environment. The control of such hazards allows the worker to perform his/her job in a productive manner, free from the debilitating effects of work-related illnesses.

Graduates will be prepared in the initial diagnosis of exposure problems in industrial settings. This will include awareness of work organization issues and ergonomic risk factors. The graduate will also be prepared in developing a sampling and evaluation strategy to characterize the extent of the problem, in the proper field collection and laboratory techniques to measure exposures, in the determination of the controls needed to solve the identified exposure problems, and in the theoretical and practical design aspects of such controls including toxics use reduction.

Graduate Program in Occupational Epidemiology

Epidemiology is the study of the distribution and determinants of disease in human populations. Today's occupational epidemiologist is called upon to identify previously unsuspected diseases caused by exposure to hazards in the work environment, to assess the health risks of new technologies, to recommend a scientific basis for the setting of occupational standards to protect worker health, and to

evaluate the ability of control technologies to limit health risks. Epidemiology is a rapidly evolving discipline using increasingly sophisticated statistical methods to quantify the risks of low level, long term exposures to hazardous physical and chemical agents. The field is highly interdisciplinary, drawing on physiology, toxicology, biostatistics, industrial hygiene and biomechanics.

To meet the need for epidemiologists in industry, government and academia, the student in the epidemiology concentration will be trained in the full spectrum of epidemiologic methods, and will acquire the necessary background in the related fields of biostatistics, physiology, industrial hygiene, and ergonomics.

Graduate Program in Work Environment Policy

Work environment policy is concerned with the study of the forces that determine the production, recognition, and control of health and safety hazards in industry. The policy analyst studies the institutions and organizations, as well as particular procedures for protecting worker health. The analyst must understand the interaction between science (and scientific uncertainty) in occupational and environmental health, and the politics of the workplace setting. The fields of occupational and environmental health are integrated by the practical focus on actual workplace conditions: policy is based on the science; engineering and political economy provide the solutions.

The Work Environment Policy concentration will provide master's level education to graduates from a wide variety of backgrounds, including the social sciences and law, who wish to be administrators of occupational health and safety programs in the private and/or public sectors, or who wish to be policy analysts in agencies and organizations concerned with affecting environmental health and worker safety and health.

Graduate Program in Clean Production/Pollution Prevention

Pollution Prevention (the preferred term in the U.S.) is the conceptual and procedural approach to production that demands that all of the life-cycle of a product should be addressed with the objective of prevention or minimization of short- and long-term risks to humans and the environment. This approach has become the standard for environmental protection efforts worldwide and a priority for industry, non-governmental organizations and government agencies. The transition to more sustainable systems of production calls for work environment professionals who not only monitor a static industrial environment, but who are also agents of change. The new specialization is one of the few programs of its kind in the U.S. It combines a working knowledge of the work environment in its core curriculum and an intensive study experience in the principles and techniques of production for sustainability. Professionals trained in this program will learn more flexible, collaborative and creative approaches to guide organizations seeking to balance production and environmental responsibility. They gain knowledge of production processes, pollution prevention, life cycle analysis, product design, financial analysis, project management, and communications and training systems.

Introductory Graduate Courses Available to Juniors and Seniors

19.500 Intro to Work Environment

An overview course to be taken as the first or second course in the Master's program. Case studies are used to introduce students first to the hazard analysis methods, and second, to the prevention methods of each of the department's sub-disciplines. Interconnections between exposures and illness/accident development are reviewed at three levels: individual, work organization and society. (3-0)3

19.503 Toxicology and Health

Comprehensive review of the toxicology and human health effects of the major chemical and physical hazards encountered in the work environment. The course examines risks associated with heavy metals, organic solvents, harmful

dusts, asphyxiants, ionizing radiation, heat stress, noise, and repetitive trauma.

Mechanisms of the effects on human physiological systems are described.

Prerequisite: 30.550 or consent of Instructor. (3-0)3

19.525 Introduction to Industrial Hygiene and Ergonomics

A survey course covering introductory topics in ergonomics and industrial hygiene. Ergonomics topics include work measurement, anthropometry, biomechanics, psychosocial stress and work reorganization, special emphasis is placed on the recognition and control of work-related musculoskeletal disorders. Industrial hygiene topics will cover the identification, measurement, and control of chemical and physical hazards in the work environment including principles of air sampling and analysis, ventilation and other control technologies, and the use of personal protective equipment with special attention to respiratory and hearing protection. (3-0)3

19.540 Design for Injury Prevention

Design of tools, equipment, and environment for the elimination or control of occupational safety hazards (industrial machinery, slips/falls/ climbing, enclosed spaces, robotics/ automated systems, etc.). Anthropometric analysis, hazard analysis, systems safety, accident investigation and reconstruction. (3-0)3

19.550 Environmental Law and Policy

Survey of relevant environmental laws and their application to public policy. A framework for understanding environmental politics will be developed. This course is also offered in the Environmental Sciences program as 18.522. (3-0)3

19.557 Toxic Use Reduction

Toxic Use Reduction (TUR) is a new approach to hazardous waste management and environmental protection. Rather than addressing chemical contamination as waste (after its generation), to be managed through permits and emission regulations, TUR focuses on chemicals while still in production. In Mass., firms are required to prepare plans demonstrating

how they will reduce or eliminate the use of toxic chemicals. The course is organized as a set of discussions and case studies from the "real-life" program. (3-0)3

19.575 Introduction to Biostatistics and Epidemiology

Provides an introduction to the principal quantitative methods for assessments of the work environment. Topics include: probability theory, the normal distribution, Gaussian statistics, linear regression, epidemiologic study designs, causal inference in epidemiology, bias, and confounding. (3-0)3



Dean of the College

Krishna Vedula, B. Tech., M.S., Ph.D.

Department Heads

Struan R. Robertson, B.S., M.S., Ph.D., P.E., Mechanical Engineering

Alfred A. Donatelli, B.S., M.S., Ph.D., Chemical Engineering

Robert E. Nunn, B.Sc., D.I.C., Ph.D., P.E., Plastics Engineering

Donald S. Pottle, B.S.E., M.S.E., P.E., Engineering Technology

Michael A. Fiddy, B.Sc., Ph.D., Electrical and Computer Engineering

William B. Moeller, B.S., M.S., Ph.D., P.E., Civil Engineering

David H. Wegman, B.A., M.S., M.D., Work Environment

Resident Faculty

Carol Barry, Assistant Professor, Plastics Engineering; B.S., Boston College; D.Eng., University of Massachusetts Lowell

Francis J. Bonner, Professor, Chemical Engineering; S.B., S.M., Massachusetts Institute of Technology; Ph.D., University of Delaware; Fil. lic. (Swedish middle degree), Fil. Dr. (Swedish Ph.D.), University of Uppsala, Sweden.

Gilbert Brown, Professor, Nuclear Engineering; B.S., Cornell University; M.S., Ph.D., Massachusetts Institute of Technology.

Clifford J. Bruell, Professor, Civil Engineering; B.S., Lowell Technological Institute, M.S., University of Lowell; Ph.D., University of Connecticut.

Bryan O. Buchholz, Associate Professor, Work Environment; B.S.E., M.S., M.S.E., Ph.D., University of Michigan.

Majid Charmchi, Professor, Mechanical Engineering; B.S., Arya-Mehr University of Technology; M.S., Ph.D., University of Minnesota.

Kavitha Chandra, Assistant Professor, Electrical Engineering; B.S., Bangalore University; M.S., D.Eng., University of Massachusetts Lowell

Julie Chen, Associate Professor, Mechanical Engineering; B.S., M.S., Ph.D., Massachusetts Institute of Technology

George P. Cheney, Associate Professor, Electrical Engineering; B.S., M.S., Lowell Technological Institute.

Donn A. Clark, Professor, Electrical Engineering; B.S., Pennsylvania State University; M.S. Northeastern University, P.E.

Aldo M. Crugnola, Professor, Plastics Engineering; A.B., Boston University; M.S. Northeastern University; Sc.D., Massachusetts Institute of Technology; P.E.

Rudolph D. Deanin, Professor, Plastics Engineering; A.B., Cornell University; M.S., Ph.D., University of Illinois.

Robert J. Dirkman, Associate Professor, Electrical Engineering; B.S., Tufts University; S.M., Massachusetts Institute of Technology.

Alfred A. Donatelli, Professor, Chemical Engineering; B.S., M.S., Lowell Technological Institute; Ph.D., Lehigh University.

Stephen B. Driscoll, Professor, Plastics Engineering; B.S., M.S.,

Lowell Technological Institute

John J. Duffy, Professor, Mechanical Engineering; B.S., Christian Brothers College; M.S., Illinois Institute of Technology; D.Sc., Washington University, St. Louis, MO; P.E.

Ellen A. Eisen, Professor, Work Environment; B.S., University of Michigan; M.S., Massachusetts Institute of Technology; M.S., Sc.D., Harvard School of Public Health.

Michael J. Ellenbecker, Professor, Work Environment; B.E.E., University of Minnesota; M.S., University of Wisconsin; M.S., Sc.D., Harvard School of Public Health.

Susan Faraji, Associate Professor, Civil Engineering; B.S., Arya-Mehr University of Technology; M.S., Northeastern University; Ph.D., University of Massachusetts.

Michael A. Fiddy, Professor, Electrical Engineering; B.Sc., Ph.D., University of London.

Nathan Gartner, Professor, Civil

Engineering; B.S., M.S., Sc.D., Technion-Israel Institute of Technology.

Kenneth Geiser, Associate Professor, Work Environment; B.Arch., University of California, Berkeley; M.C.P., Ph.D., Massachusetts Institute of Technology.

Steven J. Grossman, Professor, Plastics Engineering; B.S., University of Connecticut; Ph.D., University of Massachusetts.

William T. Hogan, Professor, Mechanical Engineering; B.S., Northeastern University; S.M., D.Sc., Massachusetts Institute of Technology; P.E.

F. Ross Holmstrom, Professor, Electrical Engineering; B.S., University of Washington; M.S., Ph.D., Stanford University.

Jan-Chan Huang, Professor, Plastics Engineering; B.S., National Taiwan University; Ph.D., University of Wisconsin.

Hilary I. Inyang, Professor, Civil Engineering; B.Sc., University of Calabar, Nigeria; B.S., M.S., North Dakota State University; Ph.D., Iowa State University

Dikshitulu K. Kalluri, Professor, Electrical Engineering; B.E., Andhra University; M.S., University of Wisconsin; D.I.I.Sc., Indian Institute of Science; Ph.D., University of Kansas.

Robert A. Karasek, Professor, Work Environment; B.A., Princeton University; M.A., University of Pennsylvania; M.S., Ph.D., Massachusetts Institute of Technology.

David Kriebel, Associate Professor, Work Environment; B.S., University of Wisconsin (Green Bay); M.S., Sc.D., Harvard School of Public Health.

Venkatarama Krishnan, Professor, Electrical Engineering; B.Sc., Madras University; B.Sc., Banaras Hindu University (India); M.S.E., Princeton University; Ph.D., University of Pennsylvania.

Walter S. Kuklinski, Associate Professor, Electrical Engineering; B.S., Lowell Technological Institute; M.S., Ph.D., University of Rhode Island

William Kyros, Professor, Mechanical Engineering; B.S., University of Lowell; S.M., Massachusetts Institute of Technology; Ph.D., Cornell University; P.E.

Fang S. Lai, Professor, Plastics Engineering; B.S., National Taiwan University; M.S., University of Notre Dame; Ph.D., Kansas State University.

Earle R. Laste, Jr., Professor, Electrical Engineering; B.S., M.S., Northeastern University; Ph.D., Worcester Polytechnic Institute.

Donald G. Leitch, Professor, Civil Engineering; B.S., Lehigh University; M.S., University of Colorado; P.E.

John P. Leonard, Associate Professor, Electrical Engineering; B.S., Lowell Technological Institute; M.S. Northeastern University.

Charles Levenstein, Professor, Work Environment; B.S., Cornell University; Ph.D., Massachusetts Institute of Technology; M.O.S.H., Harvard School of Public Health.

Robert A. Malloy, Professor, Plastics Engineering; B.S., M.S., Ph.D., University of Lowell.

Stephen R. McCarthy, Professor, Plastics Engineering; B.S., Southeastern Massachusetts University; M.S., Princeton University; Ph.D., Case Western Reserve University.

John W. McKelliget, Associate Professor, Mechanical Engineering; B.Sc., Exeter University, U.K.; Ph.D., Sunderland Polytechnic, U.K.

Samson Mil'shtein, Professor, Electrical Engineering; M.Sc., State University Odessa, USSR; Ph.D., University of Jerusalem, Israel.

Alan Mironer, Professor, Mechanical Engineering; B.S., B.M.E., Rensselaer Polytechnic Institute; M.Eng., Yale University; Ph.D., Syracuse University; P.E.

Nancy T. Miu, Associate Professor, Electrical Engineering; M.S.E.E., North Dakota State University; B.S.E.E., National Taiwan University; P.E.

William B. Moeller, Professor, Civil Engineering; B.S., Villanova University; M.S., Ph.D., University of Connecticut; P.E.

Rafael Moure-Eraso, Associate Professor, Work Environment; B.Ch.E., University of Pittsburgh; M.Ch.E., Bucknell University; M.S., Ph.D., University of Cincinnati.

Eugene E. Niemi, Jr., Professor, Mechanical Engineering; B.S., Boston University; M.S., Worcester Polytechnic Institute; Ph.D., University of Massachusetts; P.E.

Robert E. Nunn, Professor, Plastics Engineering; B.Sc., London University, D.I.C., Imperial College, Ph.D., London University; P.E.

John C. O'Callahan, Professor, Mechanical Engineering; B.S., M.S., Ph.D., Northeastern University; P.E.

Stephen A. Orroth, Jr., Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute.

Charles R. Ott, Professor, Civil Engineering; B.S., M.S., Ph.D., University of Washington; P.E.

Samuel Paikowsky, Professor, Civil Engineering; B.S., M.S., Technion-Israel Institute of Technology; Sc.D., Massachusetts Institute of Technology.

Robert E. Parkin, Professor, Mechanical Engineering; B.Sc., University of London; Ph.D. and D.I.C., Imperial College, University of London.

Martin A. Patt, Associate Professor, Electrical Engineering; B.S., Northeastern University; S.M., Massachusetts Institute of Technology.

Stephen P. Petrie, Professor, Plastics Engineering; B.S., Lowell Technological Institute, M.S., Lowell Technological Institute, Ph.D., University of Connecticut.

Donald S. Pottle, Professor, Engineering Technology; M.S.E., B.S.E., Northeastern University; P.E.

Kanti Prasad, Professor, Electrical Engineering; B.S., Agra University (India); B.E., University of Roorkee; Ph.D., University of South Carolina; P.E.

Laura Punnett, Professor, Work Environment; B.A., Hampshire College; M.S., Sc.D., Harvard School of Public Health.

Margaret M. Quinn, Associate Professor, Work Environment; B.A., Brown University; M.Sc. Industrial Hygiene, M.Sc. Physiology, Harvard University; Sc.D., University of Massachusetts Lowell.

Tenneti C.K. Rao, Professor, Electrical Engineering; B.S. Andhra University; B.S.,

M.E., Ph.D., Indian Institute of Science, Bangalore (India).

Struan R. Robertson, Professor, Mechanical Engineering; B.S., M.S., Clarkson University; Ph.D., Rensselaer Polytechnic Institute; P.E.

James H. Rome, Associate Professor, Electrical Engineering; B.S., M.S., University of Michigan; Ph.D., University of Pennsylvania.

Ziyad Salameh, Professor, Electrical Engineering; M.Sc., Ph.D., University of Michigan.

Gary S. Sales, Associate Professor, Electrical Engineering; B.S., Brooklyn College; M.S., Ph.D., Pennsylvania State University.

Nick R. Schott, Professor, Plastics Engineering; B.S., University of California, Berkeley; M.S., Ph.D., University of Arizona.

Burton A. Segall, Professor, Civil Engineering; B.C.E., Polytechnic Institute of Brooklyn, M.S.C., University of North Carolina; M.P.H., University of North Carolina; Ph.D., New York University; P.E.

James R. Sheff, Professor, Nuclear Engineering; B.S., University of Colorado; M.S., Ph.D., University of Washington; P.E.

James A. Sherwood, Associate Professor, Mechanical Engineering; B.S., M.S., Ph.D., University of Cincinnati.

Sammy G. Shina, Associate Professor, Mechanical Engineering; B.S.E.E., B.S.I.T., Massachusetts Institute of Technology; M.S., Worcester Polytechnic Institute; P.E.

David R. Smith, Associate Professor, Mechanical Engineering; B.S., M.S., Ph.D., Georgia Institute of Technology.

Stephen J. Spurk, Associate Professor, Electrical Engineering; B.S., Merrimack College; M.S., University of New Hampshire.

Ross G. Stacer, Associate Professor, Plastics Engineering; B.A., University of California, Irvine; Ph.D., University of Akron.

Chronis Stamatiadis, Associate Professor, Civil Engineering; B.S., Aristotelian University of Thessaloniki, Greece; M.S., Ph.D., Michigan State University.

Changmo Sung, Associate Professor,

Nuclear Engineering; B.S., M.S., Seoul National University, Korea; M.S., Ohio State University, Columbus; Ph.D., Lehigh University

Randall W. Swartz, Associate Professor, Chemical Engineering; B.S., Rensselaer Polytechnic Institute; Associate Professor, Chemical Engineering; M.B.A., Indiana University/Purdue University at Indianapolis; Ph.D., Rensselaer Polytechnic Institute

Amad Tayebi, Professor, Plastics Engineering; B.S., Alexandria University (Egypt); M.S., M.E., Sc.D., Massachusetts Institute of Technology.

Charles Thompson, Professor, Electrical Engineering; B.E., New York University; M.S., Polytechnic University; Ph.D., Massachusetts Institute of Technology.

John M. Ting, Professor, Civil Engineering; Associate Professor; B.S., McGill University, Montreal; M.S., California Institute of Technology; Sc.D., Massachusetts Institute of Technology; P.E.

Anh Tran, Professor, Electrical Engineering; B.Sc., National Taiwan University; M.S., Ph.D., University of Rhode Island.

Robert J. Tuholski, Associate Professor, Engineering Technology; B.S., Fitchburg State College; M.Ed., Ph.D., University of Maryland.

Thomas Vasilos, Professor, Chemical Engineering; B.S., Brooklyn College; Sc.D., Massachusetts Institute of Technology.

Fahd G. Wakim, Associate Professor, Electrical Engineering; B.S., American University of Beirut; M.A., Ph.D., University of Texas.

John W. Walkinshaw, Professor, Chemical Engineering; B.S., M.S., Lowell Technological Institute; Ph.D., University of Manchester (England); P.E.

David H. Wegman, Professor, Work Environment; B.A., Swarthmore College; M.S., Harvard School of Public Health; M.D., Harvard Medical School

Jay A. Weitzen, Professor, Electrical Engineering; B.S., M.S., Ph.D., University of Wisconsin.

John R. White, Professor, Nuclear Engineering; B.S., University of Lowell;

M.S., Ph.D., University of Tennessee.

Susan R. Woskie, Associate Professor, Work Environment; B.S. University of Massachusetts, Amherst; M.S., Harvard School of Public Health; Ph.D., Clark University.

A. David Wunsch, Professor, Electrical Engineering; B.E.E., Cornell University; S.M., Ph.D., Harvard University.

Yakov M. Zilberberg, Associate Professor, Mechanical Engineering; M.S., Technical Institute, Odessa, (USSR); Ph.D., University of New Hampshire; P.E.



College of Health Professions

The faculty of the College of Health Professions believe that each individual should have the right to an optimal level of health. The faculty further believes that a healthy population supports a strong economy. As a response to society's

need for individuals to exercise this right, the College of Health Professions provides programs to prepare health professionals on both an undergraduate and graduate level. The undergraduate programs prepare the students as general-

ists in their chosen health profession; while specialization in the graduate programs provides greater depth in knowledge, attitudes, and skills necessary for leadership in the health professions. The goals of the Ph.D. program in Nursing include the development of knowledge in the areas of health promotion, disease prevention, and health care policy. The program also aims at improvement of health care by preparing nurse scholars with expertise in the development, implementation, and evaluation of health promotion strategies and programs, and health care policy.

Janice Stecchi, Dean

Mission of the College of Health Professions

The mission of the college is to promote health through:

1. teaching of theory and practice in classroom and community based settings,
2. promoting scholarship in the discovery, application, and dissemination of knowledge and,
3. providing public service in partnership with local, regional and national organizations focusing on health.

College Organization and Governance

The College of Health Professions is organized into three departments and is administered by a dean who is assisted by an executive committee. Each of the departments is responsible for developing programs of study and course offerings. Although the faculty of the college has overall responsibility for all academic policies of the college, the academic standards committee is responsible for enforcing the academic standards of the college and also serves as a review body for suspended students seeking readmission with probationary status. In addition, each department has its own professional review committee which evaluates appeals from students who have not met the criteria for retention in their specific programs. Such appeals to professional review committees may be submitted only once, and all decisions of the faculty are final.

Executive Committee

Janice Stecchi, Dean

Beverly Volicer, Chairperson, Health & Clinical Sciences

May Futrell, Chairperson, Nursing

Joseph Dorsey, Chairperson, Physical Therapy

Baccalaureate Degree Programs

The College of Health Professions offers undergraduate programs leading to the degree of Bachelor of Science with majors in Clinical Laboratory Sciences, Community Health Education, Exercise Physiology, and Nursing. For information

concerning graduate offerings of the college, see the Graduate School Catalogue.

The course requirements for undergraduate programs of the college have been determined by specific professional objectives and are subject to the recommendations of the various professional accrediting associations. Each course of study provides a basic general education in the sciences, the psycho-social areas, and the humanities; a comprehensive introduction to the health professions; upper division professional courses; and clinical or teaching experiences in one or more community health agencies or schools. Candidates for the Bachelor of Science degree in the College of Health Professions must comply with the University general education requirements and with the rules and regulations of the College of Health Professions. The University general education requirements are described in the "Academic Policies" section of this catalogue.

Candidates for degrees in the College of Health Professions may be permitted to elect a second academic major or a minor in another college provided that all curriculum requirements of the College of Health Professions can still be satisfied. Election of a second major or minor may require an extension of the normal four-year period of undergraduate study for most students.

General College Requirements

Candidates for the baccalaureate degree in the College of Health Professions must satisfy the general University requirements for graduation, complete all courses and credits as required by the specific program of study, and meet the academic requirements of the College of Health Professions as specified in this section.

Retention and Continuance in College Programs

Irrespective of the classification policies of the University, students shall not be admitted to professional courses of the College unless they have satisfactorily completed all courses which are specified in their programs of study for the first two semesters and have achieved a cumulative grade-point average of 2.50 or better for

all such courses. Students enrolled in exercise physiology, medical technology, and nursing also are required to achieve at this time a cumulative grade-point average of 2.50 or better in their required science courses.

To qualify for continued matriculation in programs of the College of Health Professions, all students must maintain on-going cumulative averages of 2.50 or better by achieving the following averages at the end of the freshman year and at the end of each semester thereafter: 1) a semester average of 2.50 or better, 2) not less than a grade 'C' in any professional major course and 3) a semester average of 2.50 or better for professional courses attempted in the major. Students enrolled in exercise physiology, medical technology, and nursing must maintain a cumulative grade point average of 2.50 or better in their required science courses. Students who fail to satisfy these academic requirements will be dismissed from their respective programs. Such students may seek reinstatement to programs by filing a petition with the professional review committee of their respective departments. Students whose petitions for reinstatement are denied may seek transfer to another major within the University if they qualify under University policies as students with satisfactory academic standing. Students who do not qualify for such standing may be dismissed from the University at the time they are dismissed from the College of Health Professions and are ineligible for readmission as probationary students in the College of Health Professions.

All students in the College of Health Professions must demonstrate a level of professionalism and a state of emotional and physical health which will enable them to provide safe competent practice in their chosen professional field. In special cases, at the request of the professional review committee of the student's major department, an individual may be required to present statements of physical and/or mental health from appropriate physicians or psychiatrists who are fully licensed by the Commonwealth of Massachusetts. On the basis of a review of such statements, the professional review committee may recommend to the chairperson of the student's major department that the individ-

ual be denied admission to or continuance in the major program.

Appeals Procedure for Reinstatement

Students who have been denied continuance in their majors, or students who have been dismissed from a major for non-academic reasons concerning a lack of professionalism, emotional and/or physical health, may submit a written petition, in response to the letter of notification received, to the appropriate professional review committee for re-evaluation of their transcripts for the purpose of reinstatement. This petition must be received no later than the date specified in the letter of notification and may be submitted only once. In making recommendation for reinstatement, the professional review committee may recommend to the faculty specific requirements which students must satisfy as a condition of their reinstatement. The faculty will vote to accept or reject the request for reinstatement and will forward to the department chairperson and the Dean its recommendations together with a statement of requirements which reinstated students must satisfy as a special condition of their reinstatement and continued matriculation. Students who have been dismissed from their programs after having been reinstated may not petition again for reinstatement. Students who are dismissed from their major for academic reasons may obtain undeclared health status for one semester while deciding on a new major.

Academic Advising

Students in the College of Health Professions are assigned an academic advisor. Prior to each registration period, students must meet with their advisor to discuss selection of courses required by their academic programs. Students who fail to avail themselves of this opportunity and who register for incorrect courses, or who withdraw from courses in the schedule they have developed with their advisor, may find it necessary to extend their period of study and may be ineligible to continue in their major. All seniors must consult with their advisors prior to the established University deadline for filing program of study forms with the office of the dean. The program of study summa-

rizes senior-level status with respect to requirements of the curriculum and grade-point averages and insures that all stated requirements for graduation are satisfied.

Declaration of Program and Change of Program

Students entering the College of Health Professions are advised to declare a major at the time of admission. Students interested in the health professions but who are unsure of a specific major, or, students who meet the college admissions standards but do not meet the admissions requirement for a specific major, may be admitted to the college as "undeclared" health students. Undeclared health students follow the same general course of study as declared majors during their freshmen year and sophomore first semester.

By university rules, all students must declare a major once they have earned 60 credits. Transfer students wishing to enter the exercise physiology major can stay in undeclared status for two semesters regardless of the number of credits they have accumulated. Exercise Physiology, Community Health Education and Clinical Laboratory Sciences all have required courses in the major in the second semester sophomore year. Students must be declared in the major to take departmental major courses. All qualifying undeclared health students can select a major in the College; however, selection of a specific major may be restricted due to non-availability of spaces in a particular program. Whenever students make a declaration of major, they are required to first obtain approval from the department Chair and then file an official notification with the Office of Enrollment Services.

Students desiring to change their professional program within the College of Health Professions must secure the approval of the chairperson of the appropriate department. Students transferring to another major outside the College of Health Professions must apply for inter-collegiate transfer. All changes of program require official notification of the Office of the Enrollment Services. Students who change their programs within the College of Health Professions after the first year should expect possible additional course

work beyond the minimum degree requirements and extension of the normal four-year period of study.

Transfer Policies

Qualified students may transfer from other colleges in the University into specified degree programs of the College of Health Professions, on a space available basis, provided they meet the requirements as stated. Irrespective of any previous recognition by the Office of Admissions or by other colleges of the University, a student transferring from another college of the University to the College of Health Professions must meet prerequisites and academic criteria for admission to programs of the college. Students may not transfer directly into Exercise Physiology but must obtain "undeclared health status" for a minimum of one semester prior to review for acceptance into Exercise Physiology.

Students who contemplate transferring to one of the health professions majors are advised that admission to the college is competitive and requires, as a minimum, the achievement of a cumulative grade-point average of 2.50 on a 4.00 scale for all previous course work attempted. In addition, applicants for exercise physiology, medical technology, clinical sciences, and nursing, are also required to have achieved a minimum of 2.50 in their science courses. Exercise Physiology and Nursing may require cumulative grade point average of over 3.00 for admission.

Transfer from Other Institutions

Courses transferred from other institutions are initially evaluated by the Office of Admissions in terms of general university requirements. When students are admitted to the University, they are also evaluated by the professional department in terms of college and program requirements. Courses which are transferred to the University either under provisions of the Commonwealth Transfer Compact and which are not equivalent to those of the College of Health Professions or as unrestricted elective courses will be listed on students' transcripts but will not apply to the minimum degree requirements. In the event that students who have transferred to the University under the

Commonwealth Transfer Compact subsequently intercollegiate transfer to the College of Health Professions, all previously completed courses, including transferred courses from the compact institution, will be re-evaluated in terms of their applicability to degree requirements of the College of Health Professions. Decision regarding admission to the department is made by the Chair of the department. All students must satisfy all general education, prerequisite, and corequisite requirements, plus all courses in the major to be eligible for the Bachelor of Science degree from the College of Health Professions.

The applicability of grades earned in transferred courses for the determination of the grade-point average of students' majors at the University is determined by policies of each of the colleges. The policy of the College of Health Professions is to count such grades for required science courses for the purpose of determining the students' science grade-point average in their professional majors. These course grades will not be counted in overall grade point average. Students who retake required science courses to improve science cumulative average will have the highest grade earned considered when that cumulative average is calculated. All undeclared students must declare a major by the completion of 60 credits. Transfer students may request exception to this rule to have the opportunity to have "undeclared health status" while attempting to declare exercise physiology. These students will be allowed two semesters in Undeclared Health. Transfer students are not accepted directly into Exercise Physiology but must apply for Undeclared Health status.

Transfer Policies for Certified Laboratory Technicians

Current practitioners in the field including associate degree graduates with MLT (ASCP) certification may seek entry to the Department of Health and Clinical Sciences through transfer of credits acceptable to the University. Comparable didactic courses are available for challenge in the clinical practice and upper division courses.

Repetition of Transferred Courses

Students who have been granted transfer credit, and, on this basis, have been

assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form through the Office of the Dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Health Professions

Students wishing to transfer from another college of the University, or from baccalaureate continuing education programs of the University, must file a petition, together with a current transcript, with the appropriate chairperson and the Dean of the College of Health Professions. Students should refer to University policies concerning intercollegiate transfer "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details.

Readmission Policies

Students who are readmitted by the department chairperson on a space available basis into their major in the College of Health Professions must comply with the current program requirements of that major. Year of graduation based on students' previous matriculation dates becomes null and void on readmission.

Special College Requirements

All students are expected to demonstrate behavior that is generally accepted as professional. All students must demonstrate proof of purchase of professional liability insurance at the beginning of their junior year. Students are billed for this insurance by the business office, but in case of error or omission, students are advised that they must assume personal responsibility for their coverage. Registered Nurse students must provide their own professional liability insurance.

In order to participate in the clinical portion of the upper-division curriculum, all College of Health Professions students are required to be aware of their rights and responsibilities under the Massachusetts Right to Know Law. All students must supply documentation that they have completed a basic CPR course prior to entering their first clinical course. Thereafter, current CPR documentation must be presented annually for departmental approval. Prior to clinical or practicum experience as required by the curriculum, each student must have:

1. evidence of medical history and physical examination documenting health status,
2. evidence that he or she is free of tuberculosis (TB) by presenting a mantoux skin test (every 6-12 months for some clinical affiliations). A positive test requires a recent chest x-ray,
3. documentation of the following immunization:
 - a. Hepatitis B - 3 doses - Serologic proof of immunity will be acceptable.
 - b. Tetanus/Diphtheria (DT) 1 booster if 10 years since last dose.
 - c. MMR (Measles, Mumps, Rubella) 2 doses measles, 1 dose mumps, 1 dose rubella (laboratory evidence of titers indicating immunity is acceptable for Rubeola, Rubella and mumps).
 - d. evidence of chickenpox childhood history or titer indicating immunity.

Other health requirements may be mandated for specific affiliations. For a list of additional certification requirements imposed by the University on all students, refer to "Health Certification Requirements" in the Admissions section of this catalogue. In addition students in all majors must present a report of a complete physical examination before clinical experiences are scheduled. These reports are to be submitted to students' respective departments. Students are advised to consult department chairpersons for additional details.

Each exercise physiology, medical technology, and nursing student is required to wear an approved school uniform when in the clinical setting. Details concerning specific uniform requirements may be

secured from the appropriate department chairperson. Final decisions regarding clinical placements are the responsibility of the faculty of the department. All students must provide their own transportation to clinical placements. Car pools are often arranged among students. Students are advised that a CORI (Criminal Offender Record Information) check is mandated by most clinical agencies prior to practicum experiences.

Interdisciplinary Courses (Course Prefix: 30)

The following courses are offered by faculty of the several departments of the College of Health Professions and are available for election by students who are enrolled in other colleges. Registration in these courses does not guarantee non-majors a space in health professions programs.

30.120 Life Skills

This course is designed to assist new students adjust to, and succeed in college and beyond. Course subject matter has been created in conjunction with the National Collegiate Athletic Association (NCAA). This course has been specifically designed to meet the needs of the student-athletes who are current members of our campus community. Successful completion of this course will give the participants the skills necessary to be successful students, athletes, and citizens academically, socially, personally, and professionally. I, II (3,0)3

30.201 Community Health

This course emphasizes the concepts, philosophy and principles of public health and their relationship to the physical, mental, and social well-being of the community. The focus is on the prevention of disease, the promotion and maintenance of health, and the provision of environmental and personal health services through organized community effort. College faculty. I, II (3,0)3

30.301 Research and Health Care

This course focuses on the research process, examples of knowledge derived from research, and the application of this knowledge to health care. Various health care disciplines' research interests are studied for similarities and differences. The role of the media in presenting

research findings in chronic and infectious diseases and environmental health hazards is also examined. I(3,0)3

30.306 Introduction to Gerontology

This course examines human aging from a multi-disciplinary and developmental perspective. The course will focus on the adult years of the life span. The social-psychological factors involved in adjustments to the aging process, to retirement, to family, to leisure, to aloneness, to death, and bereavement are discussed together with such special concerns of the elderly as widowhood, finances, religion, sexuality, and health problems. Rehabilitative strategies such as remotivation and reality orientation are included. I,II(3,0)3

30.307 Lifestyles/Health Behaviors/Physiology

This course provides an overview of selected current health issues. Information necessary for making well-reasoned, responsible decisions about one's health will be presented and discussed. Personal and societal attitudes, beliefs, and values implicit to the decision-making process will be explored as they relate to health behavior and consequently, to health. II(0,3)3

30.312 Environment, Health and Immunity

This course will explore the effects of micro and macro environmental stressors related to public health. Stressors include exercise, nutrition, trauma, substance abuse, chemical toxins, viruses and physical factors such as electromagnetic fields and other environmental hazards. Principles behind vaccinations and experimental therapy to boost natural defenses will be discussed, in context of the importance of the immune system for health. Prerequisites: 30-201, 35-101, 35-102, II (3,0)3

30.322 Independent Study

This course focuses on a health promotion project. Must have faculty approval for the course. Can be for 1,2,or 3 credits.

30.522 Independent Study

This course is open only to graduate students who have an ongoing health promotion project. Can be used only as an elective and must be pre-approved by faculty advisor.

Department of Health and Clinical Sciences

Beverly Volicer, Chairperson

Professors: Alease S. Bruce, Kathleen Doyle, Sandra Fessia, Jacob W. Lam, Theodore Namm, Robert Nicolosi, Eugene Rogers, Beverly Volicer

Associate Professors: Michael Frechette, Mary Hooker, Shashikant Mehta, Michael O'Sullivan, Vincent Pivnicny

Assistant Professors: Nicole Champagne, Craig Slatin

Community Health Education Major

The Department of Health and Clinical Sciences offers a major in Community Health Education, leading to the degree of Bachelor of Science; a masters program in Health Services Administration, leading to a Master of Science; and a Graduate Certificate in Health Services Administration. Please see the Graduate School Catalogue for information concerning the graduate programs. Faculty of the Department believe that society, through its community and educational institutions, has a responsibility to make available for its citizens the methods and means for achieving the goal of optimal health. To this end, the department is committed to preparing professional health educators who can assist the community in achieving as high a level of health as is possible.

The College of Health Professions' Community Health Education Program endeavors to provide a high level of professional preparation for health educators. This program provides a basis for understanding the scientific foundation of health education, community needs in their social and political context, and how to address those needs through program development and implementation. All students in this major are required to complete a Community Practicum during their senior year. Graduates will be prepared to facilitate voluntary change in health behaviors and reinforce positive health behavior through effective health education programs in a variety of community, corporate, and educational settings.

Students seeking teacher certification in Health Education may apply to the Fast Track M.Ed. offered by the Graduate School of Education. Accepted students may take two graduate education courses during the senior year, in addition to the B.S. in Community Health Education requirements, and then begin the M.Ed. program in May of the senior year. Requirements for the M.Ed. can be completed within one calendar year, and graduates are then eligible for teacher certification from The Commonwealth of Massachusetts Department of Education. The program is accredited through NCATE.

Health education has emerged as an educational discipline to effectively meet society's ever-increasing need for accurate health knowledge. Health education builds its body of knowledge on the arts and sciences and deals with the theory of health science. The application of this theory to practice requires the development of effective teaching skills. These skills include the ability to develop curriculum based on health theory. This application also requires the acquisition of a variety of teaching and evaluation skills that are integral to effective health education. In addition, health-based curriculum and teaching strategies for changing negative health attitudes and behavior are developed to reinforce existing positive health attitudes and behavior. Health educators must be able to communicate effectively, particularly in the areas of public speaking and be able to maintain good relations with people of all ages. The goal of the community health education program is to prepare entry level professional practitioners who have a foundation for continuing professional development and individual growth in addition to the ability to function effectively in a variety of settings.

At the completion of the community health education program, the graduating student will be expected to:

1. Teach effectively and demonstrate mastery in the major areas of health education curriculum development;
2. Incorporate in the teaching process and interactions with people the broad based areas of knowledge existing in the liberal arts and biological sciences;
3. Recognize and acknowledge the multi-

cultural diversity of populations and incorporate this understanding into educational and professional practices;

4. Assess needs effectively and develop, present, and evaluate health education programs;
5. Demonstrate knowledge about research, current trends and issues in the areas of general education and health education for continued professional and personal growth;
6. Actively participate in developing national awareness for disease prevention and increasing the quality of life for all citizens, individually and collectively, through health education; and
7. Appreciate the applicability of computer technology to instruction and evaluation in health education.

Course of Study for Community Health Education

Freshman Year

Fall Semester

30.201	Community Health	3
35.101	Anatomy and Physiology I	3
35.103	Anatomy and Physiology Lab II	
42.101	College Writing I	3
47.101	General Psychology	3
XX.XXX	Behavioral/ Soc. Sci. Elective3	

(FROM DEPT. OTHER THAN PSYCHOLOGY)

16

Spring Semester

35.102	A & P II	3
35.104	Anatomy and Phys Lab II	1
42.102	College Writing II	3
47.260	Human Development I	3
XX.XXX	History Elective	3
XX.XXX	Values Elective	3

16

Sophomore Year

Fall Semester

35.251	Physiological Chem I	3
35.253	Physiological Chem Lab I	1
92.183	Intro to Statistics OR	

92.283	Statistics for Behav. Sciences3	
35.206	Human Nutrition	3
XX.XXX	Aesthetics Elective	3
XX.XXX	Literature Elective	3

16

Spring Semester

30.301	Research and Health Care	3
31.204	Intro Health Ed	3
35.211	Basic Clin Micro/Pathol	3
35.213	Basic Clin/Micro/Pathol Lab	1
35.252	Physiological Chem II	3
35.254	Physiological Chem Lab II	1
47.360	Human Development II OR	
30.306	Intro to Gerontology	3

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Junior Year

Fall Semester

31.302	Compu Meth for Tchg Hlth*	3
31.303	Contemp Health Problems I*3	
31.321	Health Care Systems(31.407)	3
47.328	Dynamics Interpers Rels.	3
XX.XXX	Open/Minor Elective	3

15

Spring Semester

31.301	Curriculum/Methods Tchg Hlth**	3
31.304	Contemp Hlth Probs II**	3
31.312	Environment,Hlth, and Immunity	3
31.325	Intro to Epidemiology**(31.305)	3
XX.XXX	Open/Minor Elective	3

15

Senior Year

Fall Semester

31.403	Principles Hlth Counseling***3	
31.405	Communic Tech/Hlth Prom***3	
XX.XXX	Open/Minor Elective	3
31.409	Commun Hlth Prepracticum	3

12

Spring Semester

31.410	Community Health Pract	10
31.414	Pgm. Mgmt. In Health	3
		13
Total credits required		120

*31.302, 31.303 must be taken concurrently in fall of junior year.

**31.301, 31.304 must be taken concurrently in spring of junior year.

***31.403, 31.405 must be taken concurrently in fall of senior year.

Students eligible for FAST TRACK M.ED. FOR TEACHER CERTIFICATION should contact Graduate School of Education for advice prior to beginning of senior year.

All students must come for PREREGISTRATION ADVISING every semester.

All students must have TRANSPORTATION FOR OFF CAMPUS PRACTICUM during senior year.

All students must have current CPR/FIRST AID CERTIFICATION AND IMMUNIZATION documentation report on file with department prior to beginning the 31.409 Community Health Prepracticum

Health Education (Course Prefix: 31)

31.204 Introduction to Health Education

Focuses on the role that school and community health education play in the development of healthful patterns of living. A philosophy of health education is developed. Methods of appraisal and the organization of health education are discussed. The organization and the administration of school, community and worksite health education programs are introduced. II(3,0)3

31.301 Curriculum and Methods for Teaching Education

Focuses on education methods and the various aspects and dimensions of curriculum development and planning, importance and ramifications of needs assessments, current trends and issues in the field of health education and health promotion teaching strategies, and the development of a viable health curriculum. Juniors only. I(3,0)3

31.302 Computer Methods in Health Education

Focuses on methods for using computer technology for health education programs in school, community, and occupational settings. Applications of microcomputers in program administration, teaching, and evaluation are discussed, demonstrated, and practiced. Students will review and evaluate Web sites relevant for health education and will develop web sites for computer-assisted instruction in health. Juniors only. I(3,0)3

31.303 Contemporary Health Problems I

Presents students with detailed knowledge of major contemporary health problems and issues. Assessment of individual health needs is discussed and a model for self-directed behavior change is developed. The role of health education in the prevention of disease is covered. Juniors only. I(3,0)3

31.304 Contemporary Health Problems II

Presents students with detailed knowledge of major contemporary health problems, issues and concerns. The course has been developed in concert with Contemporary Health Problems I and is an academic progression relative to the topics, concepts and health education initiatives in the treatment and prevention of disease. Juniors only. Prerequisite: 31.303 II(3,0)3

31.312 Environment, Health, and Immunity

This course will explore the effects of micro and macro environmental stressors related to public health. Stressors include exercise, nutrition, trauma, substance abuse, chemical toxins, viruses and physical factors such as electromagnetic fields and other environmental hazards. Principles behind vaccinations and experimental therapy to boost natural defenses will be discussed, in context of the importance of the immune system for health. Prerequisites: 30-201, 35-101, 35-102. II(3,0)3

31.321 Health Care Systems (was 31.407)

This course describes and analyzes the nature and functions of health care services and health professionals. The course examines the impact of social, political, economic, ethical, professional, legal, and

technological forces on them and the system they comprise. Prerequisites: 30-201. Juniors and Seniors only. I,II (3,0)3

31.325 Introduction to Epidemiology (was 31.305)

This course is designed to introduce basic epidemiological methods used in the study of current major health problems. Content includes an explanation of historical shifts in population and disease patterns, types of research designs, and simple measures of disease frequency and association used in the study of the distribution and determinants of disease. Emphasis is on applications of epidemiological methods and findings in health education. Prerequisites: 30-201, 92-183 or 92-283. Juniors and Seniors only. II(3,0)3

31.403 Principles in Health Counseling

Health counseling develops an understanding of the theory and practice of counseling, and stresses the idea that self-esteem is a basic determinant of mental health. A positive model of mental health is developed and techniques of dealing with life stresses are discussed with the objective of implementing these concepts in the health curriculum. Methods of guiding group discussions and developing programs of self-directed behavior change are covered. Seniors only. I(3,0)3

31.405 Communication Techniques in Health Promotion

This course focuses on communication techniques and mass media approaches and materials necessary to promote and implement effective community health promotion programs. Seniors only. I(3,0)3

31.409 Community Health Education Prepracticum

Prepracticum field experience and seminar, one day a week (seven hours) for fifteen weeks. Student are placed in a community agency, health organization, or corporate setting, and are introduced to the organization, roles and responsibilities of personnel, and actively participate in entry level activities. Placement is arranged by university faculty supervisors. Seniors only. I(0,7)3

31.410 Community Health Education Practicum

Full-time health education field experience (28 hours per week). Students continue at the prepracticum site, participat-

ing in the development, implementation and evaluation of health education programs and take an active part in the total community health education process.

Seniors only. II(0,28)10

31.414. Program Management in Health

The concepts of program planning, development, budgeting and evaluation, which are essential functions for individuals working in health care agencies, are presented. Starting with the mission of the organization, the steps of conceptualizing, designing, implementing, budgeting and evaluating health programs are covered. Students will be expected to develop a grant proposal for an agency. This course is a capstone experience and resources from all other relevant course work will be called upon. Seniors only. II(3,0)3

Clinical Laboratory Sciences Major

The Department of Health and Clinical Sciences offers a major which leads to a Bachelor of Science degree in Clinical Laboratory Sciences. Students may select either of two options: Medical Technology or Clinical Sciences. The Department also offers a minor in Clinical Laboratory Sciences and a Minor in Nutrition. Additionally, the Department offers a Master's Degree in Clinical Laboratory Sciences and a Graduate Certificate in Clinical Pathology. Please see the Graduate School Catalogue for information concerning the graduate programs.

Philosophy

The Faculty of the Department of Health & Clinical Sciences believe that each individual has the right to achieve and maintain an optimal level of health. As a response to society's need to have available quality clinical evaluative services necessary for optimum health, Clinical Laboratory Scientists are prepared practitioners who use current scientific and clinical knowledge towards this end. The theoretical basis of the profession are integrated with psychomotor skills practiced in clinical, research, industrial and/or community settings. This fosters a problem solving approach to the practice. The academic program includes scientific and

clinical knowledge using current methodology, instrumentation and techniques relevant to the performance of service.

These elements are integrated with a body of knowledge from the humanities, social and behavioral sciences.

Goals

1. To prepare graduates to serve as part of a health care or industrial team.
2. To prepare graduates to assume responsibility for their own continued personal and professional growth.
3. To educate professional practitioners who will be able to provide evaluative services which will assist individuals in maintaining a better quality of life.

Objectives

The objectives of the program are to: prepare entry level clinical laboratory scientists who are expected to be able to select and provide analytical and evaluative services based on scientific theory, effectively assess the results of their efforts and instill leadership skills of accountability, delegation, education and supervision.

Essential Functions/Technical Standards

In order to be successful in the Clinical Laboratory Sciences major prospective

students must meet the following non-academic criteria (essential functions):

I. Communication skills

- A. "Communicate effectively in written and spoken English
- B. Comprehend and respond to both formal and colloquial English

1. Person to person

2. By telephone

3. In writing

- C. Appropriately assess nonverbal and verbal communication."

II. Large and small motor skills

- A. "Move freely from one location to another in physical settings such as clinical laboratories, patient care areas, community care agencies, schools, cor

ridors, and elevators"

- B. Ability to use computers in data entry, administration, and education with facility

III. Professional and application skills

- A. "Follow written and verbal directions"
- B. Ability to apply mathematical skills necessary in job related problems
- C. "Work independently and with others under time constraints
- D. Prioritize requests and work concurrently on at least two different tasks
- E. Maintain alertness and concentration during a normal work period
- F. Apply knowledge, skills, and values learned from course work and life experiences to new situations"
- G. Exercise good judgment, function effectively under stress, display flexibility
- H. Recall, interpret, analyze, synthesize, evaluate and then apply the information obtained from reading, lecture, and discussion materials

IV. Professional judgment and maturity

- A. "Show respect for self and others
- B. Project an image of professionalism including appearance, dress, and confidence"
- C. Ability to function effectively using all necessary skills under normal working conditions
- D. "Recognize emergency situations and take appropriate actions"

ADDITIONAL ESSENTIAL FUNCTIONS FOR MEDICAL TECHNOLOGY AND CLINICAL SCIENCES OPTIONS IN CLINICAL LABORATORY SCIENCES

V. Large and small motor skills.

- A. Ability to perform delicate manipulations of specimens, instruments, and tools with facility and accuracy.
- B. "Grasp and release small objects (e.g. test tubes, pipette tips, microscope slides and coverslips); twist and turn dials/knobs (e.g. on microscopes, balances, centrifuges, spectrophotometers)

C. Manipulate other laboratory materials (e.g. reagents, manual and automated pipettes"

VI. Other physical requirements

- A. "Identify and distinguish objects macroscopically and microscopically
- B. Read charts, graph, and instrument scales/readout devices accurately
- C. Lift and move objects of at least 20 pounds"
- D. Ability to distinguish objects by touch and temperature

VII. Professional and application skills

- A. Work safely with potential chemical, radiological, and biological hazards using the standards established in the department chemical hygiene plan, safety manual, and the blood-borne pathogen policy
- B. Problem solve and comprehend spatial relationships of structures

Essential Functions adapted from: Body of Knowledge, American Society of Clinical Laboratory Sciences, 1998.

Medical Technology Option

Graduates of the medical technology option are qualified to write either or both of the registry examinations sponsored by the American Society of Clinical Pathologists, MT (ASCP) and the National Credentialing Agency for Clinical Laboratory Personnel, CLS (NCA). This option provides the student with the scientific knowledge, technical skills, and hands-on experience required to function in all areas of the clinical laboratory. At the time of this publication, this integrated curriculum is offered in cooperation with the following clinical affiliates:

Anna Jaques Hospital, Newburyport;
Harvard Vanguard Medical Associates, Somerville; Lahey Medical Center, Burlington; Lawrence General Hospital, Lawrence; Lawrence Memorial Hospital, Hallmark Health, Medford;

Lowell General Hospital, Lowell; Metro West Medical Center, Framingham and Natick; North Shore Medical Center, Salem; Saints Memorial Medical Center, Lowell; and Winchester Hospital, Winchester

On campus instruction provides student with didactic and simulated clinical laboratory experiences in each of the five major areas of the clinical laboratory: chemistry, hematology, immunohematology, microbiology and immunology. Hospital-based clinical rotations are integrated with the didactic laboratory curriculum during the junior and senior years of the program and supervised by adjunct clinical faculty in cooperation with the Program Director. Clinical assignments are made by the Program Director.

This option allows for upward mobility of current practitioners in the field, including associate degree graduates with MLT (ASCP) certification. The growing complexity and significance of the role of the clinical laboratory in the delivery of health care accentuates the importance to its professionals receiving an education commensurate with the responsibilities of the clinical laboratory scientist. Medical technologists perform tests on various body fluids and tissues to determine the presence or absence of disease, to monitor response to disease, and to aid in health maintenance. They are indispensable laboratory personnel - the supervisors, the instructors and/or the specialists for a wide range of complex diagnostic and therapeutic procedures. In addition, graduates of the program are prepared for graduate studies and/or employment in clinically related government and/or industrial settings.

Accreditation

The Medical Technology option of the Department of Health and Clinical Sciences is accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) (www.naacls.org) (phone number 773-714-8880).

Program Director: Kathleen Doyle, Ph.D., MT(ASCP)

Medical Director: Manlio LoConte, M.D., M.P.H., F.C.A.P

Entry Level Competencies

In accordance with NAACLS, after completion of this program, the Clinical Laboratory Scientist/Medical Technologist will be able to:

1. develop and establish procedures for collecting, processing, and analyzing biological specimens and other substances;
2. perform analytical tests of body fluids, cells, and other substances;
3. integrate and relate data generated by the various clinical laboratory departments while making decisions regarding possible discrepancies;
4. confirm abnormal results, verify quality control procedures, execute quality control procedures, and develop solutions to problems concerning the generation of laboratory data;
5. make decisions concerning the results of quality control and quality assurance measures, and institute proper procedures to maintain accuracy and precision;
6. establish and perform preventive and corrective maintenance of equipment and instruments and identify appropriate sources for repairs;
7. develop, evaluate, and select new techniques, instruments and methods in terms of their usefulness and practicality within the context of a given laboratory's personnel, equipment, space, and budgetary resources;
8. demonstrate professional conduct and interpersonal skills with patients, laboratory personnel, other health care professionals, and the public;
9. establish and maintain continuing education as a function of growth and maintenance of professional competence;
10. provide leadership in educating other health personnel and the community;
11. exercise and apply principles of management, safety, supervision, educational methodology, and current information systems."

(NAACLS Preamble, Essentials of Accredited Educational Programs for the Clinical Laboratory Scientist/Medical Technologist, 1996)

Course of Study for Clinical Laboratory Sciences**Medical Technology Option****Freshman Year****Fall Semester**

35.101	Human A & P I	3
35.103	Human A & P I Lab	1
42.101	College Writing I	3
47.101	General Psychology (Behav)	3
48.101	Intro to Sociology (Soc Sci)	3
92.121	Precalculus (Math) or	
92.127	Calculus IA (Math)	3
		16

Spring Semester

30.201	Community Health	3
35.102	Human Anatomy & Phys II	3
35.104	Human Anatomy & Phys II Lab I	
36.273	Intro to Clinical Lab Sci	2
42.102	College Writing & Lit	3
	Values Elective	3
		15

Sophomore Year**Fall Semester**

35.211	Basic Clin Micro & Pathology	3
35.213	Basic Clin Micro & Patho Lab I	
35.251	Physiological Chemistry I	3
35.253	Physiological Chemistry I Lab I	
	Aesthetics Elective	3
	History Elective	3
		14

Spring Semester

35.252	Physiological Chem II	3
35.254	Physiological Chem II Lab	1
36.241	Clin Lab Theory & Physics	3
36.243	Clin Lab Techniques	1
36.341	Organic React & Struct	3
36.343	Organic React & Struct Lab	1
	Literature Elective	3
		15

Junior Year**Fall Semester**

36.321	Clinical Hematology	3
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36.323	Clinical Hematology Lab	2
36.350	Human Biochemistry	3
36.361	Clinical Lab Instrumentation	3
36.363	Clinical Lab Instrument Lab	2
36.373	Clinical Lab Sci Seminar	1
		14

Spring Semester

36.311	Medical Bacteriology	3
36.313	Medical Bacteriology Lab	2
36.331	Clinical Immunology	3
36.351	Clinical Chemistry I	3
36.353	Clinical Chemistry I Lab	2
36.420	Clinical Hematology Practicum	2
		15

Senior Year**Fall Semester**

36.410	Clinical Micro Practicum	2
36.411	Med. Mycology and Parasitology	3
36.413	Med. Mycology and Parasitology Lab	2
36.431	Clinical Immunohematology	3
36.433	Clinical Immunohemat Lab	2
36.452	Clinical Chemistry II	3
36.454	Clinical Chemistry II Lab	2
36.473	Clinical Lab Sci Seminar	1
36.451	Clinical Urinalysis Practicum	0
		18

Spring Semester

36.415	Clinical Virology	1
36.430	Clinical Immunohem Pract	2
36.434	Advanced Hemostasis	1
36.436	Clinical Immunology/Serology Lab	1
36.450	Clinical Chem Pract	2
36.453	Laboratory Management & Ethics	2
36.474	Clinical Lab Sci Seminar	1
35.435	Medical and Clinical Genetics	3
		13

Total credits required

120

Clinical Sciences Option

By integrating their clinical and non-clinical experiences, graduates of the clinical sciences option are prepared for graduate studies and/or for industrial or government employment as research assistants, technical sales representatives, product development personnel, instrument designers, and/or technical service representatives. These students pursue a core of courses similar to students electing the medical technology option courses, but substitute additional didactic, laboratory and/or experiential opportunities. While this option is not structured to prepare graduates for certification as medical technologists, it does provide them with an opportunity to specialize in subject areas related to clinical laboratory science.

Course of Study for Clinical Laboratory Sciences**Clinical Sciences Option****Freshman Year****Fall Semester**

35.101	Human Anatomy & Physiology I	3
35.103	Human A & P I Lab	1
42.101	College Writing	3
47.101	General Psychology (Behav)	3
48.101	Intro to Sociology (Soc Sci)	3
92.183	Intro to Statistics (Math)	3
		16

Spring Semester

30.201	Community Health	3
35.102	Human Anatomy & Phys II	3
35.104	Human Anatomy & Phys II Lab	1
42.102	College Writing & Literature	3
92.121	Precalculus (Math) OR	
92.127	Calculus 1A OR	
92.131	Calculus I for Chemistry	3
	Specialization	
	Aesthetics Elective	3
		16

Sophomore Year**Fall Semester**

35.211	Basic Clin Micro & Pathology	3
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35.213	Basic Clin Micro & Path Lab	1	Free Elective	1-3
35.251	Physiological Chemistry I*	3	Laboratory Sci Spec	3-5
35.253	Physiological Chemistry I Lab	1	Laboratory Sci Spec	3-5
95.103	General Physics I	3	Laboratory Sci Spec	3-5
96.103	General Experimental Physics I	1		16-23
	Literature Elective			

Spring Semester

35.252	Physiological Chemistry II*	3		
35.254	Physiological Chemistry II Lab	1		
36.341	Org React & Struct OR Organic Chem IB+IIB	3		
36.343	Organic React & Struct Lab OR Organic Chem Lab IB+IIB	1		
95.104	General Physics II	3		
96.104	General Physics II History Elective	3		

Spring Semester

36.484	Senior Research	2		
35.435	Medical & Clinical Genetics/	3		
	Laboratory Sci Spec	3-5		
	Laboratory Sci Spec	3-5		

*Or equivalent course(with departmental approval)

Students must select six laboratory sciences with the recommendation that a majority of courses be taken within an area of interest. These six must be approved courses only. Included as a laboratory sciences course is Directed Studies. The student must take a minimum of one directed study within their specialty and a maximum of two total.

Total credits required 120

Junior Year**Fall Semester**

36.321	Clinical Hematology	3		
36.323	Clinical Hematology Lab	2		
36.350	Human Biochemistry*	3		
36.361	Clinical Lab Instrumentation	3		
36.363	Clinical Lab Instrument Lab	2		

15
16-17

Spring Semester

36.311	Medical Bacteriology	3		
36.313	Medical Bacteriology Lab	2-3		
	OR Free Elective			
36.331	Clinical Immunology	3		
36.351	Clinical Chemistry I	3		
36.353	Clinical Chemistry I Lab	2		
	Laboratory Sci Spec	3		

16-17

Senior Year**Fall Semester**

36.483	Senior Research	2		
36.451	Clinical Chemistry II	3		
36.454	Clinical Chemistry II Lab OR			

36.493	Directed Studies	3 cr
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Nutrition Minor

Students interested in the Nutrition Minor offered by the Department of Health and Clinical Sciences must first obtain the authorization of the Department and present 21 credits in the minor field with at least six credits at the upper division course level. The minor requires the following courses:

35.101	Human A & P I	3 cr
35.102	Human A & P II	3 cr
35.103	Human A & P Lab I	1 cr
35.104	Human A & P Lab II	1 cr
35.251	Physiological Chemistry I	3 cr
35.253	Physio. Chem. Lab I	1 cr
35.206	Human Nutrition	3 cr

and 6 credit hours from among the following upper division courses:

36.350	Human Biochemistry	3 cr
36.506	Biochemistry of Lipids	3 cr
36.563	Nutritional Biochemistry	3 cr
36.494	Dir Research in Nutrition	3 cr

Clinical Laboratory Sciences(Course Prefix: 35)**35.101 Human Anatomy & Physiology I**

This course provides a basic knowledge of the structure and function of the human body. An overview of the general organization of the body introduces the course. Following a discussion of basic human chemistry, the anatomy and physiology of cells, tissues, organs, and organ systems is studied with special emphasis placed on homeostasis and interaction among the various systems. The topics treated are body plan, chemistry, cytology, histology, the integumentary system, the skeletal system, the muscular system, the nervous system, and the endocrine system. Clinical applications are presented. Corequisite: 35.103. Bruce and Namm. 1(3,0)3

35.102 Human Anatomy & Physiology II

A continuation of the basic knowledge of human structure and function. The topics treated are cardiovascular system, lymphatic system, respiratory system, diges-

Clinical Science Minor

Students interested in the Clinical Sciences Minor offered by the Department of Health and Clinical Sciences must first obtain the authorization of the Department and present 18 credits in the minor field with at least six credits at the upper division course level. The minor requires the following courses:

35.101	Human A & P I	3 cr
35.102	Human A & P II	3 cr
35.103	Human A & P Lab I	1 cr
35.104	Human A & P Lab II	1 cr
35.251	Physiological Chemistry I	3 cr
35.253	Physio. Chem. Lab I	1 cr
	and 6 credit hours from among the following courses:	
36.331	Clinical Immunology	3 cr
35.435	Medical & Clinical Genetics	3 cr
35.356	Pharmacology	3 cr
36.350	Human Biochemistry	3 cr

tive system, metabolism, urinary system, and reproductive system. Prerequisites: 35.101, 35.103 (or equivalent). Corequisite: 35.104. Bruce, Hooker, and Namm. II(3,0)3

35.103 Human Anatomy & Physiology Laboratory I

Laboratory exercises are designed to reinforce didactic material by providing hands-on experience with the subject matter. Students actively participate in simple chemical analysis, microscopic observations, and studies of anatomical models and preserved specimens. Students perform simple physiological tests on themselves and work in small groups to discuss conclusions. Corequisite: 35.101. Members of the Department. I(0,3)1

35.104 Human Anatomy & Physiology Laboratory II

Laboratory exercises are designed to reinforce didactic material by providing hands-on experience with the subject matter. Students actively participate in simple chemical analysis, microscopic observations, and studies of anatomical models and preserved specimens. Students perform simple physiological tests on themselves and work in small groups to analyze results and discuss conclusions.

Prerequisite: 35.101, 103. Corequisite: 35.102. Members of the Department. II(0,3)1

35.206 Human Nutrition

This course provides an overview of nutrition and the components of a "nutritious diet" during the various stages of the life cycle. It emphasizes the impact of nutrition on the major contemporary health problems in the United States. Nutrition issues, trends and research, and their effect on society and the legislative process will be explored. Nicolosi. I,II(3,0)3

35.211 Basic Clinical Microbiology & Pathology

This course is designed to study the fundamentals of microbiology with major emphasis on structure, function, growth, metabolism and classification of clinically important microorganisms. The human body's response to invading microbes and an introduction to the ecological aspects of microorganisms in the environment with particular stress on their significance, activities (beneficial and detrimental) and control measures will also be studied.

Prerequisites: 35.102, 104. Corequisite: 35.213. Lam. I,II(3,0)3

35.213 Basic Clinical Microbiology & Pathology Laboratory

Laboratory investigations of basic properties and characteristics of microorganisms are conducted. Students will perform commonly used techniques for collecting, handling and studying clinically important microorganisms. Prerequisites: 35.102, 104. Corequisite: 35.211. Lam and Fessia. I,II(0,3)1

35.251 Physiological Chemistry I

This course provides a foundation in basic chemistry for students majoring in the Health Professions. Basic concepts covered include: properties of matter, energy, atomic and molecular structure, isotopes and radioactivity, chemical bonding, chemical formulae and reactions. Quantitative aspects of chemical processes, chemical equilibrium and the behavior of gases, including blood gases and their transport are discussed. Properties of water and solutions are studied and include units of concentration, osmosis, osmolality, and physiological fluid and electrolyte balance. The chemistry of acids, bases and buffers is reviewed with emphasis on physiological buffer systems. Quantitative aspects, acid/base balance, compensatory mechanisms and elementary diagnosis are discussed. The chemistry of inorganic trace elements and their physiological roles are investigated. Concepts of organic chemistry are introduced, including the structure and function of carbon, isomerism and the properties and selected reactions of the major functional groups important in human biochemistry. Prerequisite: 35.102. Corequisite: 35.253. Frechette I(3,0)3

35.252 Physiological Chemistry II

This course is designed to provide a foundation in basic biochemistry for students majoring in the Health Professions. Selected concepts in organic chemistry are integrated into this framework. Aspects of amino acid and protein structure are studied. The structure and function of enzymes, their effects on reaction energetics and dynamics and the diagnostic uses of enzyme assays in clinical medicine are covered. The plasma proteins, hemoglobin, and the structure and function of miscellaneous cellular proteins are reviewed. The chemistry of the nucleic

acids, protein anabolism and catabolism are studied along with selected metabolic disturbances and genetic disease. The structure and chemical properties of the simple and complex carbohydrates and lipids their metabolic pathways and cycles, and selected pathologies are studied in detail. Diagnostic tests relating to carbohydrate and lipid abnormalities are included. The course concludes with a study of chemical communication mechanisms, which includes neurotransmitters, hormonal secretions, and immunoglobulins. Prerequisite: 35.251. Corequisite: 35.254. Frechette. II(3,0)3

35.253 Physiological Chemistry I Laboratory

Laboratory experiments are conducted to complement the material covered in 35.251. Exercises dealing with properties of matter, chemical equations, qualitative analysis, energy, osmosis, chemical equilibrium and acids/bases/buffers will be performed. The qualitative properties of alcohols, aldehydes, ketones, acids and esters will be explored. Corequisite: 35.251. Members of the Department. I(0,3)3

35.254 Physiological Chemistry II Laboratory

Laboratory experiments are conducted to complement the material covered in 35.252. The chemistry of the basic biochemical molecules will be explored, including proteins, enzymes, carbohydrates, lipids, and nucleic acids. Selected aspects of metabolism and the assay of clinically significant materials will be studied. Prerequisite: 35.253. Corequisite: 35.252. Members of the Department. II(0,3)1

35.356 Pharmacology

An introduction to the chemistry, biochemistry and physiological actions of various pharmaceuticals. Fundamental concepts will be stressed and will include a discussion of drug receptors, drug receptor interactions, pharmacokinetics, enzyme induction, drug metabolism, drug safety and effectiveness and idiosyncratic reactions. Several major groups of drugs will be studied including: central nervous system stimulants, hypnotics, narcotic analgesics, anti-inflammatory drugs, cholinergics, adrenergics, adrenergic blocking drugs, antihypertensives, antihistamines, diuretics, adrenal steroids, anti-

anemic drugs and antibiotics. Articles from the current literature will be discussed. Prerequisite: 35.252. Members of the Department. II(3,0)3

35.435 Medical & Clinical Genetics

This course is designed to introduce the pathological and clinical aspects of human genetics with emphasis on prevention, diagnosis, and treatment of genetic diseases. Mendelian, cellular, and molecular genetics are covered as well as the metabolic basis of inherited diseases. Students learn the principles of genetic counseling and how it integrates with other health care disciplines. Students apply genetic counseling precepts by analyzing a condition occurring in their own family and writing a term report that embodies the results of this research. Cytogenetic disorders, the genetics of cancer, somatic cell genetics, immunogenetics, and the "switching on and off" of genes will also be discussed. The application of laboratory techniques such as autoradiography and electrophoresis to DNA extraction, DNA fingerprinting, automated DNA sequencing, RFLP analysis, PCR amplification, and cloning methodology will be presented. Pre-implantation diagnosis, germ-line alteration, and embryo cloning will also be discussed, as will their legal, ethical, and moral implications. Current progress on the Human Genome Project will also be reported. Prerequisites: 35.102, 35.251, 35.253. Namm. II(3,0)3

Medical Technology and Clinical Sciences(Course Prefix: 36)

36.241 Clinical Laboratory Theory and Physics

This course is designed to introduce the theoretical principles and applications of diagnostic techniques and the procedures of the clinical laboratory including phlebotomy. It will define and describe both qualitative and quantitative, manual and automated laboratory techniques, particularly in hematology. Corequisite: 36.243. Members of the Department. II(3,0)3

36.243 Clinical Laboratory Techniques Laboratory

A laboratory course designed to expose prospective clinical scientists to many of the essential skills, methods, and procedures basic to professional performance in the clinical laboratory; to explain and

demonstrate to students and have them perform these methods; to develop an understanding of these techniques and to provide a technical background, an approach to testing that the student can build upon and use in future courses. Prerequisite: 35.252. Corequisite: 36.241. Members of the Department. II(0,4)1

36.273 Introduction to Clinical Laboratory Sciences

A course designed to introduce students to aspects of the clinical laboratory sciences. Topics include the basic clinical laboratory, professional organizations and professional issues using discussions, demonstrations, field trips, guest lecturers and selected readings. Doyle and members of the Department. II(0,2)2

36.311 Medical Bacteriology I

A study of the cultural, biochemical, genetic, serological and pathogenic characteristics of disease producing microorganisms. Emphasis will be placed on the pathophysiology of the infectious diseases and their relationship to isolation and identification of the pathogenic microorganisms. Prerequisites: 35.211, 35.213. Corequisite: 36.313. Fessia. II(3,0)3

36.313 Medical (Clinical) Bacteriology Laboratory I

This course is designed to introduce the student to pathogenic microorganisms, media and techniques used in the identification of these organisms. Emphasis will be based upon the isolation, identification and differentiation of pathogenic microorganisms common to man. In addition, quality control and antimicrobial susceptibility testing will be covered. Corequisite: 36.311. Fessia, members of the Department. II(0,6)2

36.321 Clinical Hematology

A study of the human hematopoietic system and its relationship to other organ systems. Discussions will include morphological and biochemical relationships of erythropoiesis and leukopoiesis in health and disease states. A study of the mechanics of blood coagulation as it relates to health and disease states will also be included. Prerequisites: 35.102, 104, 35.252. Corequisite: 36.323. Hooker. I(3,0)3

36.323 Clinical Hematology Laboratory

This course is designed to emphasize current hematological and coagulation proce-

dures used in today's clinical laboratory. The implications of these tests to diagnose, monitor and evaluate the various hematological disorders are also discussed. Corequisite: 36.321. Hooker and members of the Department. I(0,6)2

36.331 Clinical Immunology

An introduction to the principles of immunology including: the study of antigens and antibodies and their interactions and controls; description of cellular events and the immune response, and in vivo and in vitro antigen-antibody interactions with clinical relevance. Immunological aspects of transplantation, autoimmune disease, immunodeficiencies and cancer pathogenesis are also discussed. Prerequisite: 35.211, 35.213. Bruce. II(3,0)3

36.341 Organic Reactions and Structure

This course surveys the principles of organic chemistry important for the study of clinical chemistry and human biochemistry. The chemistry of carbon compounds, bonding and the concepts of isomerism will be studied. Detailed information is presented on each of the major functional classes of organic compounds, including: hydrocarbons, halides, alcohol, phenols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, amines, organosulfur compounds. Emphasis is placed on chemical structure, physical and chemical properties, common and IUPAC nomenclature, and chemical reactions and their mechanisms. Selected aspects of the properties and synthesis of polymeric materials are presented. Qualitative analysis of organic compounds is discussed with emphasis on the use of spectral techniques, including infra-red and nuclear magnetic resonance spectroscopy for the elucidation of chemical structure. Prerequisite: 35.251. Corequisite: 36.343. Frechette. II(3,0)3

36.343 Organic Reactions and Structure Laboratory

Laboratory exercises are performed to supplement the material covered in 36.341. Corequisite: 36.341 Frechette. II(0,3)1

36.350 Human Biochemistry

This course is an in-depth study of biochemical substances and their reactions in the body, with major emphasis placed on metabolism at the cellular level, and examined in the tissues of the various

organs where these reactions occur. Correlation of biochemical processes underlying pathologic conditions will be made whenever practical. Prerequisite: 35.252, 35.254. Doyle. I(3,0)3

36.351 Clinical Chemistry I

This course is designed to introduce the clinical techniques of biochemical measurement in body fluids. These techniques range from general to specific assays and from the classical to the up-to-date state of the art methodologies. Biochemical measurements of the following in the normal state and alterations due to pathophysiology are discussed: amino acids, proteins, carbohydrates and lipids. Quality control of assay procedures is emphasized. Prerequisites: 36.341, 343, 36.350, 36.361, 36.363 or permission of instructor. Corequisite: 36.353. Rogers. II(3,0)3

36.352 Clinical Chemistry Laboratory I

This course is designed to introduce clinical laboratory procedures by studying the following compounds: carbohydrates, proteins, non-protein nitrogen compounds, porphyrins and lipids. Methods for troubleshooting, calibration and quality control will be emphasized. Prerequisite: 35.252 or permission of instructor. Corequisite: 36.351. Members of the Department. II(0,6)2

36.361 Clinical Laboratory Instrumentation

This course is designed to provide an in-depth knowledge of clinical chemistry laboratory instrumentation. Emphasis is placed on theoretical concepts, instrument components and design, calibration and troubleshooting of modern instrumentation, and analytical methodologies in the clinical laboratory. Additionally, qualitative and quantitative applications of instrumental techniques are covered. Computer applications are included where appropriate. The following spectroscopic instruments are studied: ultraviolet, visible and infra red absorption, fluorescence, turbidimetry and nephelometry, reflectance, flame emission and atomic absorption spectroscopy. Electrochemical methods of analysis are reviewed, including potentiometric techniques, voltammetry and coulometry. Chromatographic instrumentation and methods are discussed, such as column and thin layer chromatography, high pressure liquid chromatography, gas

chromatography, and ion exchange chromatography. Prerequisite: 36.241 or 95.103. Corequisite: 36.363. Frechette. I(3,0)3

36.363 Clinical Laboratory Instrumentation Lab

Laboratory exercises will be performed to supplement the material covered in 36.361. Corequisite: 36.361 Frechette. I(0,4)2

36.373 Clinical Laboratory Sciences Seminar

This course is designed to familiarize students with government regulations (including CDC & OSHA) concerning the clinical laboratory. Students also will gain computer experience in word processing, data base spreadsheet functions internet use, and their applications in the clinical lab. Finally, students learn how to write a scientific research paper and to make a public presentation. Fessia. I(1,0)1

36.410 Clinical Microbiology Practicum

Supervised clinical training in an affiliated clinical laboratory, designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical microbiology laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation. Prerequisites: 36.311, 36.313. Doyle and members of the Department. I(0,8)2

36.411 Medical Mycology and Parasitology

Intensive study of classification, morphology, physiology, genetics and ecology of medically important fungi and parasites. Emphasis on epidemiology, pathogenicity and diagnosis. Prerequisites: 36.311, 36.313. Corequisite: 36.413. Fessia. I(3,0)3

36.413 Medical Mycology and Parasitology Laboratory

The laboratory is designed to emphasize principles and procedures used in the isolation, cultivation, and identification of medically important fungi and parasites. Corequisite: 36.411. Fessia, members of the department. I(0,4)2

36.415 Clinical Virology

This course is designed to survey pathogenic viruses emphasizing diagnosis of disease. Evaluation of new technology and diagnostic tests with reference to diagnosis and prognosis of disease are examined. Fessia. II(1,0)1

36.420 Clinical Hematology Practicum

Supervised clinical training in an affiliated clinical laboratory. Designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of a clinical hematology laboratory. Emphasis will be placed on quality control, methodology, and clinical interpretation and correlation. Prerequisites: 36.321, 323. Doyle, members of the Department. II(0,6)2

36.430 Clinical Immunohematology Practicum

Supervised clinical training in an affiliated clinical laboratory is designed to reinforce knowledge and skills gained in lecture and laboratory and, at the same time, introduce the student to the daily activities of the clinical immunohematology laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation and correlation. Prerequisites: 36.331, 431, 433. Doyle, members of the Department. II(0,6)2

36.431 Clinical Immunohematology

Lecture and case study discussions look at the major red cell antigen/antibody systems which are of importance in understanding transfusion therapies, compatibility testing, and pathological diseases. Emphasis is on differentiation and clinical significance of each system. Donor selection regulations, component preparation, and hemotherapy will also be discussed. Prerequisites: 36.331. Corequisite: 36.433. Doyle. I(3,0)3

36.433 Clinical Immunohematology Laboratory

Practical laboratory experience in blood banking, illustrating the concepts stressed in the lecture. Prerequisite: 36.331. Corequisite: 36.431. Doyle, members of the Department. I(0,4)2

36.434 Advanced Topics in Hemostasis

This course will constitute an in depth study of the hemostatic mechanism. Current research and case studies on the roles of vessel endothelium, platelet function, clotting procoagulants and fibrinolysis will be presented. students will diagnose pathologic hemostatic states, such as hemorrhage or thrombophilia, due to deficiencies and impairments of these roles, including the impact of natural and acquired anticoagulants/inhibitors and anticoagulant therapy. Prerequisites:

36.321, 36.323. Hooker II(1,0)1

36.436 Clinical Immunology/Serology Laboratory

This laboratory is designed to instruct students in the principles and techniques used in the clinical immunology setting. Students will become proficient in laboratory techniques such as immunodiffusion, ELISA, hemagglutination, and neutralization techniques used for immunodiagnosis. Prerequisite: 36.331 Members of the Department II(0,3)1

36.450 Clinical Chemistry Practicum

Supervised clinical training in an affiliated hospital clinical laboratory. Designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation and correlation. Prerequisites: 36.452. Doyle, members of the Department. II(0,6)2

36.451 Urinalysis Practicum

A one week clinical rotation in an affiliated laboratory designed to give the student experience in microscopic examination and evaluation of urine sediments. Emphasis is on correlating physical and chemical characteristics with sediment evaluation and diagnoses as well as on quality control, methodology, and clinical interpretation and correlation. Additional routine tests of a physical and chemical nature will be performed and demonstrated. Prerequisites: 36.452, 454. Doyle, members of the Department. II(0,1)0

36.452 Clinical Chemistry II

This course is designed to introduce clinical techniques of biochemical measurement in body fluids. These techniques range from general to specific assays and from the classical to the up-to-date state of the art methodologies. Biochemical measurements of the following in the normal state: urinalysis, blood gases, acid-base balance, electrolytes, osmolality, hemoglobin, toxicology, therapeutic drug monitoring, and endocrinology, as well as alterations due to pathophysiology, are discussed. Quality control of assay procedures is emphasized. Prerequisite: 36.351. Corequisite: 36.454. Rogers. I(3,0)3

36.453 Laboratory Management and Ethics

This course will acquaint the student with the many managerial, educational, technical, and administrative theories and practices, as well as moral and ethical issues that may confront the health care professional functioning within a clinical or research laboratory setting. In addition, it will present the varied career opportunities that are available for graduates. Hooker. II(2,0)2

36.454 Clinical Chemistry Laboratory II

This course, a continuation of 36.353, is designed to instruct the student in the analytical procedures and methods currently used in the clinical laboratory. Manual and automated methods utilized in the assessment of such topics as acid-base balance, porphyrins, toxicology and vitamins will be introduced. In addition, methods associated with the routine examinations of urine will be introduced. Quality control, laboratory safety and professional performance are emphasized. Prerequisite: 36.351, 36.353. Corequisite: 36.452. Members of the Department. I(0,6)2

36.473 Clinical Laboratory Sciences Seminar

This course is designed to familiarize the student with different interview skills and approaches to resume writing, computer system usage in the clinical laboratory, and the tools required to be a good educator. Members of the Department. I(1,0)1

36.474 Clinical Laboratory Sciences Seminar

This course is designed to familiarize the student with different types of questions used in the national certification exams and to give the student the opportunity to practice taking mock certification examinations. Members of the Department. II(1,0)1

36.483 Senior Research

Students along with their faculty advisor will structure a research project commensurate with the students' areas of interest. A paper embodying the results of the research project will be prepared. Members of the Department. I(0,6)2

36.484 Senior Research

Continuation of 36.483. Members of the Department. II(0,6)2

36.493 Directed Studies

Students along with their faculty advisor will structure an acceptable project in one of four areas: research, program development, teaching, or clinical practicum. Students are eligible to earn three credits in accordance with departmental policy. Members of the Department. I,II(0,6)3

36.494 Directed Research in Nutrition

Students with their faculty advisor structure a research project in the area of nutrition. A paper embodying the results of project will be prepared. Members of the Department. I,II(0,6)3

36.506 Biochemistry of Lipids

This advanced course in the nutritional biochemistry and physiology of lipids will detail the role of lipids in the normal and pathological processes at both the cellular and whole organism level. Topics will range from general discussions of the digestion, absorption and transport of lipids to the role of eicosanoids and lipid soluble anti-oxidants during normal and diseased states, such as atherosclerosis, diabetes and hypertension. Subject matter will also include a discussion of the various interventions for the prevention and treatment of certain of these disease states. There will also be discussion of the current issues in lipid nutrition. Prerequisite: 36.350. Nicolosi II(3,0)3

Department of Physical Therapy

Joseph A. Dorsey, Chairperson

Professors: Barbara Cocanour, Linda Kahn-D'Angelo, Joseph Dorsey

Associate Professors: Claire Chamberlain, Susan O'Sullivan, Joyce Dorsey

Associate Professors: Connie Seymour, Claire Chamberlain, Joyce White

Assistant Professors: Sue Bergmeier, Sean Collins, Brian Don Gerard Dybel

Academic Coordinators Clinical Education:

Physical Therapy, Lisa Falvo

Exercise Physiology, Claire Chamberlain

Exercise Physiology Major

UMass Lowell's Bachelor of Science program in Exercise Physiology focuses on the general and specific physiological effects of exercise on the human systems. The curriculum combines liberal arts courses, basic sciences, professional courses, and clinical practica.

The Exercise Physiology program was specifically designed as a career pathway into graduate education in physical therapy. The enhanced curriculum ensures a smooth transition for graduates of the program, most of whom move on to advanced studies in physical therapy. Graduates who choose to begin their careers immediately are prepared to work as practitioners in fitness centers, cardiac rehab centers in hospitals and physicians' offices, or in worksite fitness programs.

The program is housed in the Physical Therapy Department, where undergraduate exercise physiology students are supervised, mentored, and counseled by faculty who assist them in their quest to become physical therapists.

Exercise Physiology Major Course of Study

Course of Study for Exercise Physiology

Freshman Year

Fall Semester

35-101 Human Anatomy & Physiology I 3

35-102 Human Anatomy & Physiology Lab I 1
42-101 College Writing I 3
47-101 General Psychology 3
92-183 Intro to Statistics 3
Historical Elective 3
16

Spring Semester

35-102 Human Anatomy & Physiology II 3
35-104 Human Anatomy & Physiology Lab II 1
42-102 College Writing II 3
48-101 Intro. to Sociology 3
Elective 3
47-260 Human Development I 3
16

Sophomore Year

Fall Semester

35-251 Physiological Chemistry I 3
35-253 Physiological Chemistry Lab I 1
95-103 General Physics I 3
96-103 General Experimental Physics I 1
30-206 Human Nutrition 3
Literature Elective 3
14

Spring Semester

35-252 Physiological Chemistry II 3
35-254 Physiological Chemistry Lab II 1
95-104 General Physics II 3
96-104 General Experimental Physics II 1
38-202 Intro. to Exercise Physiology 3
Elective 3
30-201 Community Health 3
17

Junior Year

Fall Semester

38-305 Exercise Physiology I 4
38-307 Exercise Physiology Lab I 1
47-328 Dynamics of Interpersonal Relationships 3
38-315 Kinesiology and Lab 4

36-350 Human Biochemistry 3
15

Spring Semester

38-406 Exercise Physiology II 4
38-408 Exercise Physiology Lab II 1
30-306 Intro. to Gerontology 3
47-272 Abnormal Psychology 3
Aesthetics Elective 3
14

Senior Year

Fall Semester

35-356 Pharmacology 3
38-412 Clinical Practicum (1/2 the class) 4
38-418 Seminar 3
38-417 Research Methods in Exercise Phys. 3
38-422 Exercise Prescription & Programming 3
16

Spring Semester

Values Elective 3
31-407 Health Care Systems 3
Elective 3
38-402 Indep. Study in Exercise Physiology 3
12

OR

Fall Semester

35-356 Pharmacology 3
31-407 Health Care Systems 3
38-417 Research Methods in Exercise Phys. 3
38-422 Exercise Prescription & Programming 3
12

Spring Semester

38-418 Seminar 3
38-412 Clinical Practicum (1/2 the class) 4
Values Elective 3
Elective 3
38-420 Indep. Study in Exercise Physiology 3
16

Exercise Physiology (Course Prefix: 38)

38.202 Introduction to Exercise Physiology

Introduces students to the major in Exercise Physiology. Objectives of the major are covered along with present and future uses of exercise physiology. Guest speakers are used to enhance the student's knowledge regarding the profession. II(3,0)3

38.305 Exercise Physiology I

This first course of a two-course sequence will examine the effects on the skeletal, muscular, neurological and integumentary systems. The lecture portion of this course will introduce the students to understanding the concepts of physiological and metabolic functioning of the human body during physical activity. Students taking this course are advised that the capability to exercise moderately and maximally will be necessary. Prerequisite: 38.202. Corequisite: 38.307. I(4,0)4

38.307 Exercise Physiology I Lab

This course must be taken concurrently with 38.305. It offers students the opportunity to test and evaluate physiological concepts and skills discussed in the lecture. Student physical examinations completed prior to each academic year should include cardiopulmonary status indicating exercise capability. Documentation must be provided to the Department prior to entering this laboratory course. Prerequisite: 38.202. Corequisite: 38.305. I(0,3)1

38.315 Kinesiology and Lab

Focuses on a process of examining the anatomical and mechanical concepts required for critical assessment, description, and qualitative analysis of human motion. The laboratory portion of the course introduces the student to the techniques used to analyze human motion. Prerequisite: successful completion of all first and second year Exercise Physiology courses. I(3,1)4

38.406 Exercise Physiology II

This course, the continuation of Exercise Physiology I, deals with the physiological and metabolic functioning of the human systems during physical activity. This portion of the sequence deals with the cardiorespiratory, urogenital, digestive and

endocrine systems. Prerequisites: 38.305, 38.307. Corequisite: 38.408. II(4,0)4

38.408 Exercise Physiology II Lab

This course is designed to provide the student with hands on experience in a variety of laboratory techniques that can be utilized in calculating and assessing the neurological, cardiorespiratory, urogenital and endocrine systems. Prerequisites: 38.305, 38.307. Corequisite: 38.406. II(0,3)1

38.412 Clinical Practicum I & II

This course is an off-campus experience in either a cardiac/pulmonary rehab clinical facility or corporate fitness setting. Students experience practical applications of those concepts and theories learned in the classroom settings. Students are provided a seminar atmosphere on their return to the campus to discuss current research and literature relative to experiences they have had while on clinical. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys. course work. Corequisite: 38.418. I,II(0,12)4

38.417 Research Methods in Exercise Physiology

The lecture content involves an in-depth study of current research methods and research topics with specific applications to the field of Exercise Physiology. The content will examine the sources of data acquisition, sampling, instrumentation or testing devices, research design, testing procedures, and treatment of data. Each student must participate in a senior research project utilizing information gained from the lecture portion of this class. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys course work.. II(3,0)3

38.418 Seminar in Exercise Physiology

This course is specifically designed to enhance the practicum experiences of Exercise Physiology students in their senior year. Corequisite: 38.412 I, II (3,0)3

38.420 Independent Study in Exercise Physiology

This course is the capstone course in Exercise Physiology. Students summate and synthesize the teachings and experiences in Exercise Physiology into one culminating, progressive and descriptive project. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys. course work. II(3,0)3

38.422 Exercise Prescription & Programming

This course is an essential foundation of the conceptual approach to exercise prescription and programming, applying physiological, organizational, and educational principles in the practical setting. Factors which impede or enhance exercise compliance and progress will be explored. Clinical teaching skills, safety, and professional behavior will be underscored. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys. course work. I(3,0)3

Admission Requirements

1. A high school diploma
2. High school grades of B (3.0) or better
3. Completion of high school program that is specifically college prep courses which includes English, mathematics, biology, chemistry, and physics
4. Combined SAT scores totaling at least 1,000 (mathematics and verbal)
5. Evidence of good health through a physical exam which demonstrates the ability of the student to actively participate in all phases of laboratory work
6. The capacity and willingness to work in a group environment.

Department of Nursing

May Futrell, Chairperson of the Department

Nina Coppens, Director of the Baccalaureate Program

Professors: Nina Coppens, Cheryl Cox, May Futrell, Lee Ann Hoff Karen Melillo, Susan Reece, Janice Stecchi

Associate Professors: Janet Douglass, Margaret Edmands, Barbara Mawn, Arlene McGrory, Carole Pearce, Eileen Williamson

Assistant Professors: Judith Conahan, Sharon George, Susan Houde, Mary Ann Kelly, Patricia Ottani, Laurel Radwin, Joyce Wells

Director, Nursing Laboratories:

Pauline Ladebauche

Nursing Major

The nursing program prepares a professional nurse who is a competent, beginning practitioner and has a foundation for graduate study. The goal of the undergraduate program in nursing at the University of Massachusetts Lowell is to prepare professional nurses who have the abilities to apply professional standards in a variety of settings serving diverse populations; to demonstrate knowledge of health promotion, advocacy, and health policy; and to participate as members of the nursing profession.

Graduates of the nursing program are prepared to function in a variety of health care settings such as hospitals, long term care facilities and nursing homes, schools and day care centers, visiting nurse associations, clients' homes, community and mental health agencies, and work environments. Graduates are eligible to sit for the Board of Registration in Nursing's NCLEX examination for licensure as a registered nurse.

The nursing program is approved by the Massachusetts Board of Registration in Nursing and is fully accredited by the National League for Nursing.

The Department of Nursing's mission is to educate students, advance knowledge, and provide public service according to profes-

sional nursing standards. Health promotion needs are addressed and the potential of the region is advanced through excellence in the discovery, application, integration, and dissemination of nursing knowledge and creative insights.

Upon successful completion of the University of Massachusetts Lowell undergraduate program in nursing, graduates are prepared as a generalist for beginning professional nursing roles. Specifically, the faculty believes that the graduates are prepared to:

1. develop therapeutic relationships with individuals, families, and groups;
2. utilize critical thinking and ethical principles in the implementation of standards of practice;
3. collaborate with clients and professionals in the delivery of care;
4. utilize research findings in practice;
5. demonstrate practice of health promotion activities;
6. participate in efforts to influence health care policy;
7. assume responsibility for life-long learning and professional career development.

Clinical Laboratory Placements

Courses in the nursing major are offered within the Department of Nursing and are under the direct control and supervision of the nursing faculty. The clinical aspects of the nursing program are developed, coordinated, and supervised by the nursing faculty and are provided in collaboration with members of the utilized community agencies. Placements include: Beth Israel Deaconess Medical Center, Edith Nourse Rogers Memorial Veterans Hospital, Greater Lawrence Family Health Service, Holy Family Hospital, Lawrence General Hospital, Lowell General Hospital, schools and day care centers, University of Massachusetts Medical Center, VNA of Greater Lowell, Massachusetts General Hospital, Boston Children's Hospital, Massachusetts Eye and Ear Infirmary, Tewksbury Hospital, Homecare Inc. of Andover, Saints Memorial Medical Center, Winchester Hospital, rehabilitation centers and nursing homes, and other community

based health care providers.

Additional agencies are utilized when necessary to enhance student learning. Clinical placement of students is at the discretion of the supervising faculty. Students are expected to provide transportation to clinical experiences.

Required Uniforms

To participate in the practicum portion of the curriculum, students are required to purchase an official uniform with insignia, appropriate shoes, a student name pin, stethoscope, and a watch with a second hand. Students not meeting the uniform policies as stated at the beginning of the clinical experience will be asked to leave the clinical agency and will have to make up lost time. Student uniform does not include extra jewelry, ankle socks, bright colored sweaters, sneakers or clogs. The official uniform and extra school insignias are obtained from McGill's, Inc., Manchester, NH. A company representative comes to campus and orders are taken during the spring semester of the sophomore year for availability for clinical experiences in the fall of the junior year. Registered nurse students may wear their own uniforms but must attach a University of Massachusetts Lowell insignia to this uniform and wear a student name pin while in the clinical area for student experiences. Students must present themselves in a professional manner in any clinical setting and in accordance with the agency policies where they are assigned.

Transfer Policies for Registered Nurses

The Department of Nursing is committed to encouraging registered nurses who possess a diploma or an associate degree to return for further study leading to a baccalaureate degree with a major in nursing.

Application for admission to the full-time day program of the University is made through the Admissions Office. Acceptance of credit for transfer courses is determined by the Chairperson of the Department, once official transcripts have been received. Several articulation agreements have been signed with associate degree programs in nursing. Course descriptions may be requested by the

appropriate department chairperson to determine if courses meet specific curriculum requirements. Completed transfer of credit forms become a part of the students' transcripts. Part time study for prerequisite and elective courses is available to registered nurses through the day school, continuing education, and summer school. Faculty are available to advise prospective students upon request. Registered nurses entering the Department through transfer admissions must meet the same requirements as other students, namely a 2.5 overall cumulative average and a 2.5 science cumulative average. A photocopy of current nursing license, current CPR certification and insurance coverage must be submitted to the Department, and a record of continuous coverage for both documents must be provided according to expiration dates.

Registered nurses are encouraged to utilize the opportunity to gain credit for previous learning through CLEP or equivalency examinations. All students must take 33.307 Concepts for Baccalaureate Nursing.

Registered Nurses who are graduates of diploma and associate nursing programs may be awarded advanced standing through a combination of transcript evaluation, course equivalency procedures, examinations, and/or articulation agreements.

42.101	College Writing I
42.102	College Writing II
35.251	Physiol Chem I*
35.252	Physiol Chem II*
35.253	Physiol Chem Lab I*
35.254	Physiol Chem Lab II*
	OR
84.111	Gen Chem I*
84.112	Gen Chem II*
84.113	Gen Chem Lab I*
84.114	Gen Chem Lab II*
35.101	A & P I*
35.102	A & P II*
35.103	A & P Lab I*
35.104	A & P Lab II*
35.211	Microbiology*

35.213	Microbiology Lab*
92.283	Stats for Behav. Sci
47.101	General Psychology
47.260	Human Develop I
48.101	Intro to Sociology
30.201	Community Health
30.206	Human Nutrition
30.306	Intro to Gerontology

*Students must achieve a cum of 2.5 in the combination of science courses

Retention, Continuance, Grading Policies, and Appeals Procedure

To qualify for continued matriculation in the nursing program, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions.

All nursing students' coursework will be reviewed for an overall cumulative average of 2.5 and a science cumulative average of 2.5 before entering the first semester of the sophomore year regardless of the number of credits earned at the University of Massachusetts Lowell at that point.

Students who have been denied continuance in the nursing major for academic reasons or students who have been dismissed from the program for non-academic reasons may appeal for reinstatement. The appeal procedure for reinstatement is outlined in the policies of the College of Health Professions.

Withdrawal

Students who wish to withdraw from any nursing course are advised that such withdrawal may result in termination of enrollment in the nursing program.

Such students who wish to apply for readmission to the nursing program as members of subsequent graduation classes are advised that consideration for readmission is determined not only by academic eligibility requirements in effect for the class to which admission is sought but also by enrollment quotas. Accordingly, students are advised to confer with the Chairperson of the Department of Nursing prior to applying for readmission in order to ascertain if program vacancies exist.

Department of Nursing (Class Entering 1999 and Following)

Freshman Year

Fall Semester

42-101	College Writing I	3
47-101	General Psychology	3
35-101	Human A & P I	3
35-103	Human A & P I Lab	1
48-101	Intro to Sociology	3
TOTAL		13

Spring Semester

42-102	College Writing II	3
47-260	Human Develop I	3
35-102	Human A & P II	3
35-104	Human A & P II Lab	1
	Elective (aesthetics)	3
	Elective (values)	3
TOTAL		16

Sophomore Year

Fall Semester

35-251	Physiol Chem I	3
35-253	Physiol Chem I Lab	1

OR

84-111	General Chemistry I	3
84-113	General Chem. I Lab 1	
35-211	Basic Microbiology	3
35-213	Basic Microbiology Lab	1
30-201	Community Health	3
	Elective (history)	3
TOTAL		14

Spring Semester

35-252	Physiol Chem II	3
35-254	Physiol Chem II Lab 1	

OR

84-112	General Chemistry I	3
84-114	General Chem II Lab 1	
30-206	Human Nutrition	3
30-306	Intro to Gerontology	3
92-283	Stats for Behav Sci	3
	Elective (literature)	3
TOTAL		16

Junior Year**Fall Semester**

33-301 Research & Health Care	3
33-310 Health Promotion & Risk Reduction of Families I	4
33-311 Health Promotion & Risk Reduction of Families Prct. I	3
33-312 Concepts of Prof. Nsg.	3
33-313 Nsg. Assessment & Skills	3
TOTAL	16

Spring Semester

33-314 Health Promotion & Risk Reduction of Families II	5
33-315 Health Promotion & Risk Reduction of Families Prct. II	4
33-316 Family Seminar	2
33-317 Pathopharmacology	5
TOTAL	16

Senior Year**Fall Semester**

33-410 Nsg. Care of Clients with acute & life threatening illnesses	5
33-411 Nsg. Care of Clients with acute & life threatening illnesses Prct.	4
33-412 Comm Health & Health Policy	4
TOTAL	13

Spring Semester

33-413 Role Transition	4
33-414 Role Practicum	6
33-415 Comm Health Project Elective (free)	3
33-415 Comm. Health Project	3
TOTAL	16

Nursing (Course Prefix: 33)

33.301 Research and Health Care
This course focuses on the research process, examples of knowledge derived from health research, and the application of this knowledge. Health care research interests and methodology of various disciplines are examined. This course can be taken prior to but no later than the fifth

semester. Pre-requisite 92.283 Statistics for the Behavioral Sciences or equivalent. Members of the Department. I(3,0)3

33.307 Concepts for Baccalaureate Nursing

This course is designated as a transition course for registered nurse students pursuing a baccalaureate degree with a major in nursing. This course aims to refine critical thinking skills and analyze nursing's unique contributions to health care.

Consideration is given to the interrelationships of theory, research, and practice. Special emphasis is placed on the concepts of health promotion and risk reduction as they relate to individuals and families who are at risk for or experiencing health problems. This course includes a practicum component which focuses on the development of interventions to promote the health of individuals and families at risk. II(3,6)6

33.310 Health Promotion and Risk Reduction of Families I

This course focuses on health promotion and risk reduction with individuals and young families who are responding to potential or actual physical and psychosocial health problems. Content is centered on holistic nursing care from a lifespan perspective beginning in pregnancy and ending with adolescence. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.311, 33.312, 33.313. Members of the Department. I(4,0)4

33.311 Health Promotion and Risk Reduction of Families I, Practicum

This community-based clinical course is focused on health promotion of young families including childbearing women, infants, children, and adolescents. A portion of the clinical experience consists of establishing a relationship by the student with a family. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.312, 33.313. Members of the Department. I(0,9)3

33.312 Concepts of Professional Nursing Practice

Nursing as a health profession is introduced in this foundation course. The concepts of health promotion, communication, critical thinking, culture, nursing theory and research, and therapeutic nursing interventions are presented. Within the

context of the American Nurses' Association Standards of Clinical Nursing Practice, standards of professional performance are introduced and standards of care are emphasized. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.311, 33.313. Members of the Department. I(3,0)3

33.313 Nursing Assessment and Skills

This laboratory course introduces and builds upon the students' communication and health assessment skills as applied to the Standards of Clinical Nursing Practice. Emphasis is placed on the integration and application of these skills through the use of critical thinking. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.311, 33.312. Members of the Department. I(2,3)3

33.314 Health Promotion and Risk Reduction of Families II

This course focuses on health promotion and risk reduction with adults and their families who are responding to potential or actual physical and psychosocial health problems. Content is centered on holistic nursing care throughout the adult lifespan. Prerequisites: 33.301, 33.310, 33.311, 33.312, 33.313. Corequisites: 33.315, 33.316, 33.317. Members of the Department. II(5,0)5

33.315 Health Promotion and Risk Reduction of Families II, Practicum

In this clinical course, students provide nursing care to adult clients and their families. The focus is the development of specifically tailored therapeutic interventions to promote the health of these clients and assist with potential or actual health problems. Corequisites: 33.314, 33.316, 33.317. Members of the Department. II(0,12)4

33.316 Family Seminar

This seminar provides the opportunity for students to analyze in-depth health care experiences with families. Students apply principles of health promotion during home visits to assigned families. Characteristics of diverse families are compared and contrasted. Corequisites: 33.314, 33.315, 33.317. Members of the Department. II(2,0)2

33.317 Pathopharmacology

This course combines pathophysiology: the study of dynamic aspects of disease

processes, with pharmacology: the study of drugs prescribed to prevent, diagnose, cure or care for disease processes. The nursing focus highlights major health problems across the lifespan. Content includes etiology, pathogenesis, clinical presentation, implications for treatment and pharmacological management. Corequisites: 33.314, 33.315, 33.316. Members of the Department. II(5,0)5

33.410 Clients with Acute and Life Threatening Illnesses Across the Lifespan

This course addresses the nursing care of individuals with common acute and life threatening illnesses across the lifespan. Particular attention is paid to nursing care of clients with increasing complexity and acuity levels. Prerequisites: 33.314, 33.315, 33.316, 33.317. Corequisites: 33.411, 33.412. Members of the Department. I(5,0)5

33.411 Clients with Acute and Life Threatening Illnesses Across the Lifespan, Practicum

In this clinical course, students provide nursing care to individuals with common acute and life threatening illnesses. The focus is the development of specifically tailored therapeutic interventions in providing care to clients across the lifespan. Corequisites: 33.410, 33.412. Members of the Department. I(0,12)4

33.412 Community Health and Health Policy

This course analyzes the development of policy and its impact on the health of populations. Students apply epidemiology and community health science to population-based nursing practice. Corequisites: 33.410, 33.411. Members of the Department. I(4,0)4

33.413 Role Transition

This capstone course focuses on the transition to the professional nursing role. Content includes professional issues, trends, and leadership and management principles which impact on nursing practice. Students analyze nursing practice in relation to the standards of professional performance. Prerequisites: 33.410, 33.411, 33.412. Corequisites: 33.414, 33.415. Members of the Department. II(4,0)4

33.414 Role Transition, Practicum

During this clinical experience, students

work collaboratively with nurse preceptors and other members of the health care team. Students become increasingly self-directed in carrying out the professional nursing role. Corequisites: 33.413, 33.415. Members of the Department. II(0,18)6

33.415 Community Health Project

The student applies standards of nursing practice with community as client. The project involves a community assessment and participation in the development, implementation, and/or evaluation of a community health intervention. Corequisites: 33.413, 33.414. Members of the Department. II(3,0)3

Faculty of the College of Health Professions

Janice M. Stecchi, R.N., B.S., M.Ed., M.S., Ed.D., Dean

Department Chairpersons

Joseph A. Dorsey, B.S., M.S., C.A.G.S., Ed.D., Physical Therapy

May Futrell, R.N., B.S., A.M., Ph.D., Nursing

Beverly J. Volicer, B.A., M.A., M.P.H., Ph.D., Health and Clinical Sciences

Resident Faculty

Sue Bergmeier, Assistant Professor, Physical Therapy, P.T., B.S., Russell Sage; M.A., Columbia University; Sc.D., Boston University

Alease Bruce, Professor, Health and Clinical Sciences; B.S., Hampton University; Ph.D., Howard University.

Claire Chamberlain, Associate Professor, Exercise Physiology; B.S. Ed., Ed.M., Tufts University; C.A.G.S., Northeastern University.

Nicole Champagne, Assistant Professor, Health and Clinical Sciences; B.S., Stonehill College; M.Ed., Bridgewater State College

Barbara A. Cocanour, Professor, Physical Therapy; A.B., Defiance College; M.S., Ph.D., University of Maine.

Sean Collins, Assistant Professor, Physical Therapy; P.T., B.S., University of Massachusetts Lowell; M.S., University of Massachusetts Lowell

Nina Coppens, Professor, Nursing; R.N., B.S., M.S., Northern Illinois University; M.A., Ph.D., University of New Hampshire.

Cheryl Cox, Professor, Nursing; R.N., B.S., University of Tennessee; M.S., Vanderbilt University; Ph.D., University of Rochester; Certificate in Business Administration, University of Illinois.

Brian Don, Assistant Professor, Exercise Physiology; B.S., Brighton University (U.K.); M.S. Boston University; Ed.D., Boston University.

Joseph A. Dorsey, Professor, Physical

Therapy; P.T., B.S., Springfield College; M.Ed., Northeastern University; C.A.G.S., New York University; Ed.D., Boston University.

Janet Douglass, Associate Professor, Nursing; R.N., B.S.N., St. Anselm College; M.S., Boston College; D.N.Sc., Boston University.

Kathleen M. Doyle, Professor, Health and Clinical Sciences; M.T. (ASCP), B.S., University of Massachusetts Amherst; M.S., Ph.D., University of Lowell.

Gerard Dybel, Assistant Professor, Physical Therapy; B.S., Indiana University; M.Ed., University of Toledo; M.S., The U.S. Army/Baylor University.

Margaret Edmands, Associate Professor, Nursing; R.N., B.S., Simmons College; M.S., E.D., Boston University.

Michael Frechette, Associate Professor, Health and Clinical Sciences; B.S., Merrimack College; Ph.D., University of Rhode Island.

May Futrell, Professor, Nursing; R.N., B.S., A.M., Columbia University; Ph.D., Brandeis University.

Sharon George, Assistant Professor, Nursing; R.N., B.S., Northeastern University; M.S., University of Lowell.

Lee Ann Hoff, Professor, Nursing; R.N., B.S.N., St. Louis University; M.S.N., The Catholic University of America; Ph.D., Boston University.

Mary Elizabeth Hooker, Associate Professor, Health and Clinical Sciences; M.T. (ASCP), Cambridge Hospital School of Medical Technology; B.A., Boston University; M.S., Ph.D., Georgetown University.

Susan Houde, Assistant Professor, Nursing; R.N., B.S., Lowell State College; M.S., University of Lowell; Ph.D., Brandeis University.

Linda A. Kahn-D'Angelo, Professor, Physical Therapy; P.T., B.A., Merrimack College; M.A., Texas Women's University; D.Sc., Boston University.

Mary Ann Kelly, Assistant Professor, Nursing; R.N., B.S., St. Anselm College School of Nursing; M.S., Boston University School of Nursing; Ed.D., Boston University.

Jacob W. Lam, Professor, Health and Clinical Sciences; B.S., University of Illinois- Urbana-Champaign; M.S., University of Tennessee-Knoxville; Ph.D., University of Massachusetts Amherst.

Barbara Mawn, Associate Professor, Nursing; R.N. Diploma, Massachusetts General Hospital School of Nursing; B.S.N., Northeastern University; M.S., Boston University School of Nursing; Ph.D., Brandeis University.

Arlene McGrory, Associate Professor, Nursing; R.N. Diploma, The Charles E. Gregory School of Nursing of Perth Amboy General Hospital; B.S.N., Russell Sage College; M.S.N., Boston University; D.N.Sc., Boston University.

Shashikant R. Mehta, Associate Professor, Health and Clinical Sciences; B.S., University of Bombay; M.S., University of Scranton; Ph.D., University of Texas, Houston.

Karen Melillo, Professor, Nursing; R.N., B.S., Salem State College; M.S., University of Lowell; Ph.D., Brandeis University.

Ted Namm, Professor, Health and Clinical Sciences; B.S., M.S., Fordham University; Ph.D., University of New Hampshire.

Robert J. Nicolosi, Professor, Health and Clinical Sciences; B.A., St. Anselm College; M.S., Ph.D., University of New Hampshire.

Michael O'Sullivan, Associate Professor, Health and Clinical Sciences; B.A., Northeastern University; M.P.H., D.P.H., University of California, Berkeley.

Susan O'Sullivan, Associate Professor, Physical Therapy; B.S., M.S., Ed.D., Boston University.

Carole W. Pearce, Associate Professor, Nursing; R.N. Diploma, Butterworth School of Nursing; A.S., Michigan State University; B.S.N., St. Anselm College; M.S., Boston University; Ph.D., Boston College.

Vincent C. Pivnicny, Associate Professor, Health and Clinical Sciences; A.B., Lafayette College; M.S.B.A., Boston University; Ph.D., University of Pittsburgh.

Laurel E. Radwin, Assistant Professor, Nursing; R.N., A.S. Nursing, Santa Monica College; B.S.N., Northeastern University; M.S.N., Boston College; Ph.D., Boston College.

Susan Reece, Professor, Nursing; R.N., B.S., Russell Sage College; M.S., Boston College; D.N.Sc., Boston University.

Sandra L. Fessia Richardson, Professor, Health and Clinical Sciences; B.A., University of Texas; M.S., Ph.D., Wayne State Medical School.

Eugene Rogers, Professor, Health and Clinical Sciences; M.T. (ASCP), B.S., Lowell State College; M.S., Ph.D., Northeastern University.

Connie Seymour, Assistant Professor, Physical Therapy; M.S., California State Polytechnic University; M.P.T., Baylor University; Ph.D., University of Toledo.

Craig Slatin, Assistant Professor, Health and Clinical Sciences; B.A., University of Massachusetts Boston; MPH, Boston University; Sc.D., University of Massachusetts Lowell.

Janice M. Stecchi, Professor, Nursing; R.N., B.S.N., Boston College; M.Ed., Salem State College; M.S., Ed.D., Boston University.

Beverly J. Volicer, Professor, Health and Clinical Sciences; B.A., University of Iowa; M.A., M.P.H., Ph.D., University of Michigan.

Joyce White, Associate Professor, Physical Therapy; B.S., University of Connecticut; M.S., Boston University; D.Sc., Boston University.

Joyce Wells, Assistant Professor, Nursing; R.N. Diploma, Mt. Auburn Hospital School of Nursing; B.S.N., Fitchburg State College; M.S.N., University of Massachusetts, Worcester.

Eileen Williamson, Associate Professor, Nursing; R.N., B.S., Lowell State College; M.S., D.N.Sc., Boston University.

Professional Support Staff

Lisa Falvo, Academic Coordinator of Clinical Education, Physical Therapy; B.S., University of Lowell; M.S., Springfield College.

Nancy Grandbois, Clinical Medical Technology; M.T. (ASCP), B.A., B.S., Cedar Crest College; M.S., Northeastern University.

Pauline Ladebauche, Director, Nursing Laboratories; R.N., B.S., Lowell State College; M.S., Boston University.

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Stephen Moses, Program Director, Center for Health Promotion: B.A., Queens College; M.S.Ed., Indiana University; M.B.A., University of Massachusetts Lowell; Ph.D., University of Missouri-Columbia

Donna Rogers, Professional Technician I, M.T. (ASCP), B.S., University of Massachusetts Lowell

Patrick Scollin, Director, Computer Laboratories; M.T. (ASCP), B.A., St. Anselm College; M.S., Northeastern University.



The College of Management (COM) is fully accredited at the undergraduate and graduate levels by the AACSB - The International Association for Management Education. The College offers undergraduate programs of study leading to the Bachelor of Science in Business Administration (BSBA) with concentrations in five areas of management and the Bachelor of Science in Industrial Management (BSIM). Refer to the Graduate School Catalog for information about graduate programs

in the College. Following the AACSB philosophy, the College endeavors to create the intellectual climate required to offer a dynamic, high quality undergraduate education in management through a challenging curriculum. To enhance the quality of the management program, the faculty of the College is actively engaged in research, consulting, and other scholarly activities designed to support a major focus on institutional excellence.

The College of Management promotes economic development by offering high quality and interdisciplinary educational programs, internships, and by conducting both applied and theoretical research that enhance manufacturing and other sectors of the economy. These activities provide students with the knowledge, skills, and sound ethical foundations to function effectively in a rapidly changing global environment.

Programs are designed to foster the development of broad integrative skills, using leading edge business technology, and a problem solving orientation that can be applied to all functional areas of management. The emphasis is to facilitate achievement of corporate as well as broader economic and national goals through the analysis and advocacy of private and public sector policies and practices that enhance organizational performance in an internationally competitive environment.

Kathryn Verreault, Ph.D., Dean

College of Management



Objectives of the College of Management

The faculty of the College has developed curricula intended to provide an education at the leading edge of the theory and practice of management. Students are trained to function successfully as professionals in business and non-business organizations. The College's faculty actively engages in research and publishes widely in professional journals. The College places a high value on classroom instruction. A variety of teaching methods are utilized with emphasis on lecture and case method techniques.

The College also participates in efforts to revitalize the region's economy. The resources and experience of the College faculty and students are available to assist in the solution of problems faced by business and governmental units in the state, region, and beyond.

College Organization and Governance

The College is organized into two departments: Accounting and Management (which houses Finance, Management, Management Information Systems, Manufacturing and Marketing). The faculty of the College has overall responsibility for academic policies of the College.

General College Requirements

Candidates for undergraduate degrees must satisfy the general University requirements for graduation and must complete all requirements as specified by one of the established curricula within the College.

Students may elect a second concentration in the College of Management provided they complete all requirements specified by the concentration. Students who matriculate in other colleges of the University may minor in Business Administration.

Residency Requirement

In addition to the minimum University residency requirements, the College of Management requires the senior year work, with minor exceptions, to be taken

in residence at the University of Massachusetts Lowell.

Declaration of Program

Students enrolled in the College of Management are required to specify their degree program upon enrollment. Students pursuing the Bachelor of Science in Business Administration degree follow a core program for the first two years and after completing specific filter courses must apply to be admitted to the upper division and to declare a concentration with the Office of Enrollment Services. During the first semester of their senior year, students in both the BSBA and BSIM degree programs are required to file a Declaration of Intention to Graduate (DIG) form with their advisor or the department's designated DIG officer.

Policies for Undergraduate Programs

I. Undergraduate Admission Requirements

Students entering the University as a freshmen in the College of Management must be registered as Industrial Management (IM) if pursuing the BSIM degree, or Business Administration (BA) if pursuing the BSBA degree. Upon completion of the first semester of the sophomore year, BA students may apply to be admitted to the upper division program and to declare a concentration. The College offers concentrations in Accounting, Finance, Management, Marketing, and Management Information Systems (MIS).

Transfer students may apply for transfer admission to the College of Management according to the transfer rules described in sections II and III below. Business Administration students may apply for admission to upper division COM programs described in section III on the following page.

II. Undergraduate Transfer Rules

The College of Management welcomes transfer students from Massachusetts community colleges and other regionally accredited institutions to the BSBA and BSIM programs. All College of Management students including transfer students from other accredited institutions and from other colleges of University of

Massachusetts Lowell initially enter the BSBA program as Business Administration students. After completing the filter courses, students apply to be admitted to the upper division and to declare a concentration according to the upper-division admission policies stated in section III on the following page. Students entering UMass Lowell with an associate degree may apply to be admitted directly to the upper division. Transfer students who have not earned an associate degree and transfer more than 45 credits toward the BSBA program may apply to be admitted to the COM upper division after completion of the filter courses. Students wishing to transfer to the BSIM program should have at least a 2.300 (on a 4.000 scale) grade point average. All students must complete at least 60 academic credits in residence at University of Massachusetts Lowell subject to exceptions specified in this catalogue.

A. Transfer From Other Institutions

Students transferring to the College of Management from any program not included in the Commonwealth Transfer Compact, with or without an associate degree, must have a cumulative grade point average of at least 2.000/4.000. Students wishing to transfer to the BSIM program should have at least a 2.300/4.000 grade point average. Students may not transfer any course in which they earned a grade of less than C- (1.700 on a 4.000 scale). Courses at a level below the first COM requirements, such as algebra or the first semester of a two semester precalculus sequence, are not transferable. Also, courses deemed equivalent to: Organizational Behavior, Business Finance, Operations Management, and Management Information Systems, taught by the College as part of its upper division core must be validated by departmental exam provided the course was taken after completing the prerequisites and a grade of C or better was earned in each of these courses. Courses that are equivalent to courses taught by the College in the upper division (junior and senior level) which are not a part of the COM core requirements cannot be used to satisfy the minimum degree requirements of the BSBA degree in the College of Management.

Transfer From Massachusetts Community Colleges

Students transferring with an Associate in Science, Business Transfer Option, from a member of the Commonwealth Transfer Compact can transfer all courses up to a maximum of sixty-six (66) credits.

Although all transferred courses are listed on the student's transcript, due to differences in program requirements at different institutions, some courses may not apply to minimum degree requirements at the College of Management. Courses at a level below the first COM requirements, such as algebra or the first semester of a two semester precalculus sequence, are examples of such courses. However, the student transferring with an associate degree, Business Transfer Option, will be eligible to take upper level courses in the College of Management subject to the stated prerequisites for each course. Additionally, courses at these institutions deemed equivalent to the upper level COM core (Organizational Behavior, Business Finance, Operations Management, and Management Information Systems) may also be transferred providing: a) the course was taken after completing the prerequisites; b) a grade of C or better was earned in the course; c) the appropriate validation exam was passed; and d) a written articulation agreement covering the course exists between the College of Management and the institution from which the student is transferring. Courses taught by the College as part of its upper division core that are not acceptable for transfer may be validated by departmental exam. Courses that are equivalent to courses taught by the College in the upper division (junior and senior level) which are not a part of the COM core requirements cannot be used to satisfy the minimum degree requirements of the BSBA degree in the College of Management. A student transferring to the College of Management with an associate degree is prohibited by University policy from pursuing further off-campus study.

B. Intercollegiate Transfer

An intercollegiate transfer student to the College of Management must be in good standing and have completed at least 15 credits at the University of Massachusetts Lowell. Upon acceptance, the student will

be listed as Business Administration (BA) or Industrial Management (IM) and will usually be permitted to enroll only in lower division courses.

The transfer request is normally initiated by the student and is submitted to the College of Management. Students must submit a completed change of major form obtained from the Office of Enrollment Services, the Office of the Dean of the College, or any department in the College.

University of Massachusetts Lowell students intending to apply for intercollegiate transfer to the College of Management should do so preferably before completing 60 credits (prior to completing the sophomore year). This will minimize delays in completing their educational objectives since COM upper division courses are restricted to juniors and seniors in the College of Management with appropriate prerequisites who have been admitted to upper division according to rules stated in Section III of the Policies for Undergraduate Admissions.

C. Transfer From Other COM Departments

Once admitted to the College of Management upper division program, a student can choose to enroll in any concentration within COM. Depending on the number of unrestricted electives available in the curriculum of the concentration a student is entering and the number of credits completed by the student at the time of transfer, some courses may not be usable in the student's new program, requiring the student to take courses above and beyond the University's minimum graduation credit requirements. All courses stay on the student's transcript at the University and are included in the determination of the cumulative grade point average as specified by University policies. No student shall be permitted more than two intercollegiate transfers.

III. Admission to Upper Division

All BSBA students must apply to be admitted to the upper division program in a concentration of their choice upon completion of the filter courses listed below. Minimum criteria for admission to upper division is an overall grade point average

of 2.000/4.000.

- 60.201 Accounting/Financial
- 49.201 Economics I
- 49.211 Statistics I
- 92.122 Differential Calculus
- 42.101 College Writing I
- 42.102 College Writing II
- 47.101 General Psychology
- 48.101 Intro. to Sociology

For students transferring from another institution, a course deemed equivalent to any of the above courses by the College of Management will be used to meet this requirement.

Application for admission is submitted directly to the office of the Dean. The application must include: a completed change of major form obtained from the Office of Enrollment Services, the Office of the Dean of the College, or any department in the College.

Admission to the College of Management upper division is guaranteed for a transfer student if she/he has completed an Associate in Science, Business Transfer Option, and the above mentioned courses.

Individuals who are not eligible to declare a concentration after earning 60 credits but who satisfy University retention requirements may file for intercollegiate transfer within the university. Students who are ineligible to file for intercollegiate transfer or are denied admission to another college following application for intercollegiate transfer are dismissed from the University.

IV. Special Academic Policies for Undergraduates

The following rules govern the applicability of courses satisfying curriculum requirements in any COM concentrations:

A. A student may transfer a course that COM offers in its upper division (junior and senior years) if the course was taken at a school accredited by the AACSB. The International Association for Management Education, and a grade of 'C' or better was earned. The only exception is for courses designated as introductory business core courses by COM (for example, Business

Finance, Marketing Principles, Organizational Behavior, etc.) which may be transferred subject to passing a written validation examination administered by the appropriate COM department. A copy of the completed written examination must be submitted to the College of Management to be placed in the student's permanent COM file.

B. Upper division College of Management courses (300 and 400 level) are restricted to matriculated students who have been admitted to the upper division program and have completed all prescribed prerequisites. Transfer students may not count any courses that require validation or which are not creditable to the COM concentration towards this requirement.

C. COM upper division courses are restricted to:

1. juniors and seniors enrolled in COM;
 2. juniors and seniors enrolled in another college of the University whose major requires completion of specific business courses; and
 3. special students who meet appropriate prerequisites.
- D. All College of Management students must take all upper division management courses in the day program.
- E. An unrestricted (free) elective (designated non-COM) for COM students is any course satisfying one of the following criteria:
1. a 100 level course from any college;
 2. a course designated as an intercollegiate course by any college of the University;
 3. an unrestricted course from the College of Arts and Sciences;
 4. a course listed as satisfying a University area distribution requirement;
 5. a course that applies towards a student's minor in another college; or
 6. a course allowed by an approved academic petition.

Any course taken in violation of these rules may not be used to fulfill COM curriculum requirements regardless of the grade.

V. Graduation Requirements

In addition to satisfying degree requirements listed in this catalogue under "University Academic Policies" and under "College of Management," COM majors must also satisfy the following requirements:

A. Residency Requirement

COM majors must take all required upper division courses in residence in the day programs of COM. Any exceptions to this (for international study, etc.) must be approved by the appropriate department chairperson and the Office of the Dean prior to enrolling in such courses. No approvals for transfer credit of any required course taken at any other institution will be granted after the course has been completed except as noted above for transfer students.

B. Degree Requirements

In order to qualify for a baccalaureate degree offered by the College of Management, each undergraduate student must satisfy all course requirements applicable to the major and their area of concentration and must earn a cumulative grade point average of 2.200 in all management courses (6x.xxx) and a 2.000 in all courses.

Baccalaureate Degree Programs Bachelor of Science in Industrial Management

In cooperation with the College of Engineering, the College of Management offers the Bachelor of Science in Industrial Management program. This program is designed to provide students with a specialized education in technological and management areas.

The Industrial Management curriculum combines the elements of a program in operations management and manufacturing with a basic foundation in engineering. The Industrial Management graduate is equipped to assume managerial and administrative responsibilities in technologically-oriented firms including the management of complex production activities or the marketing of specialized equipment.

Course of Study for Industrial Management

(Bachelor of Science in Industrial Management)

Freshman Year

Fall Semester

25.107	Introduction to Engineering I	2
25.110	Engineering Seminar	0
42.101	College Writing I	3
49.201	Economics I	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
		16

Spring Semester

42.102	College Writing II	3
47.101	Introduction to Psych	3
49.202	Economics II	3
92.132	Calculus II	4
25.108	Introduction to Engineering II	2
	Free Elective	3
		18

Sophomore Year

Fall Semester

22.201	Mech Design Lab I	2
48.101	Intro to Sociology	3
60.201	Accounting/Financial	3
92.234	Differential Equations	3
95.141	Physics I	3
96.141	Exp Physics I Lab	1
		15

Spring Semester

22.202	Mech Design Lab II	2
92.386	Stats for Sci. and Eng.	3
60.202	Accounting/Managerial	3
63.210	Operation Anal Tech	3
95.144	Physics II	3
96.144	Exp Physics II Lab	1
		15

Junior Year**Fall Semester**

16.211	Fund of Electricity	3
22.211	Eng Mechanics 1	3
62.201	Marketing Principles	3
60.331	Cost Mgmt Systems	3
63.371	Operations Management	3
		15

Spring Semester

10.308	Engineering Materials	3
10.347	Thermo and Heat Trans	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
	Elective, Aesthetic	3
		15

Senior Year**Fall Semester**

22.473	Design for Manufacturing	3
63.301	Mgmt Info Systems	3
63.471	Managerial Quality Control	3
	Human Values Elective	3
	Elective, Literature	3
		15

Spring Semester

63.475	Sim of Mfg Systems	3
66.490	Strategic Management	3
	Elective, IM/COM*	3
	Elective, non-COM global	3
	Elective, Free	3
		15

*IM/COM electives: See your College of Management IM advisor.

Bachelor of Science in Business Administration

The Bachelor of Science in Business Administration degree provides students with a foundation in the liberal arts and sciences, as well as analytical skills and specialized professional courses which enables them to function as effective professional managers. Course work in the first two years focuses on the liberal arts, mathematics, sciences and introductory

professional skills courses. These subjects provide the foundation on which the advanced courses are built. In the liberal arts and sciences, emphasis is upon written English, the behavioral and social sciences, and mathematics. The professional skill courses include accounting, economics, and statistics.

As juniors and seniors, students concentrate in professional programs offered by the College of Management. The College curriculum offers concentrations in five areas of management: Accounting, Finance, Management, Marketing, and Management Information Systems (MIS). The upper-level curriculum starts with introductory management courses covering the functional areas found in organizations. Through the junior and senior year each student will complete a course of study in at least one concentration. Given the increasing importance of global competition and its impact on both public and private sectors in the U.S., the College also includes an international component in all curricula. Regardless of concentration, students have sufficient electives to permit them to tailor programs to their special interests.

Minor in Business Administration

The College of Management offers a Business Administration minor for students not majoring in the College. Students must file a Declaration of Minor form with the College before registering for 300 level courses. In order to earn a minor, students must file an academic petition approved by the College of Management with the Office of Enrollment Services. This petition should be filed immediately after registering for the final courses completing the minor. Courses required for the minor are as follows:

Semester I

49.201	Economics I
60.201	Accounting/Financial

Semester II

62.201	Marketing Principles
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Semesters III and IV

61.300	Introduction to Investments
63.301	Management Info Systems
66.301	Organizational Behavior
	COM Elective

Department of Accounting

Charles Feeney, Chairperson

Professors: Clairmont P. Carter,
Charles F. Feeney, Linda H. Kistler

Associate Professors: Samuel Chesler,
J. Stephen Collins, John G. Hamer, Norma
Powell, Sherre Strickland,
Charles Thompson, Kathryn Verreault

Accounting Concentration

(Bachelor of Science in
Business Administration)

The accounting concentration prepares students for professional positions in management accounting, industry, or public accounting by providing students with quantitative analytical skills necessary for developing and analyzing financial information for all types of institutions. Data accumulation, analysis, and interpretation, together with communication of results, are fundamental activities of professional accountants. The accounting courses contain numerous general ledger and spreadsheet projects, reinforcing computer literacy and project orientation.

Course of Study for Business Administration

Accounting Concentration
(Bachelor of Science in Business
Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Management Precalculus (or non-COM)	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Management Calculus	3

43.	History Elect	3
	Elective, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, Science	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

60.301	Intermed Accounting I	3
60.321	Cost Accounting	3
63.301	Mgmt Info Systems	3
61.301	Business Finance	3
	Elective, Aesthetics	3
		15

Spring Semester

60.302	Intermed Accounting II	3
60.303	Accounting Info. Systems	3
66.301	Organizational Behavior	3
63.371	Operations Management	3
	Elective, COM	3
		15

Senior Year**Fall Semester**

60.401	Advanced Financial Acct.	3
60.	Elective, Accounting	3
	Elective, COM	3
	Elective, Literature	3

Elective, Values	3
	15

Spring Semester

60.431	Federal Income Taxes	3
66.490	Strategic Management	3
	Elective, COM or non-COM	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Accounting (Course Prefix: 60)**60.201 Accounting/Financial**

Presents a comprehensive, detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the statement of financial position and the income statement, accounting for the assets, liabilities, and stockholders' equity of the firm, and cash flow and financial statement analysis. 3 cr.

60.202 Accounting/Managerial

Examines the use of accounting systems for managerial decision making. Budgeting, forecasting, and cost accumulation systems which relate to manufacturing firms will be studied. Prerequisite: 60.201. 3 cr.

60.301 Intermediate Accounting I

Examines the generally accepted accounting principles relating to the preparation of financial statements. The student will study, in depth, the valuation and disclosure problems associated with the assets of the firm. Prerequisite: 60.202. 3 cr.

60.302 Intermediate Accounting II

Presents the in-depth study of the valuation and disclosure problems associated with corporate liabilities and stockholders' equity. Emphasis is placed on the pronouncements of the Financial Accounting Standards Board. Prerequisite: 60.301. 3 cr.

60.303 Accounting Information Systems

Provides an analysis of modern accounting information systems. Topics include the design, implementation, and evaluation of information systems, including computer applications. Prerequisite: 60.301. 3 cr.

60.321 Cost Accounting

An examination of the manufacturing function from the view of the cost accountant. Managerial control of the elements of product costs will be studied with an emphasis on cost accumulation systems both historical and estimated. Prerequisite: 60.202. 3 cr.

60.331 Cost Management Systems

This course is an upper level management accounting course for non-accounting majors. It takes a decision-oriented approach and focuses on the manager's view, as opposed to the accountant's view, of the decision process and its related information needs. Traditional cost accounting and new cost management models will be explored and contrasted, but the emphasis will be on cost management systems which examine a proactive role in planning, managing, and reducing costs. Prerequisite: 60.202. 3 cr.

60.401 Advanced Financial Accounting I

Explores theoretical and practical problems in accounting for large, multicorporational business entities. Consolidation, mergers, home office/branch accounting, and international accounting topics receive in-depth study. Prerequisite: 60.302. 3 cr.

60.402 Advanced Financial Accounting II

Offers a comprehensive study of partnership accounting, accounting for installment and consignment sales, and also includes an introduction to accounting for nonprofit organizations (government, educational units and hospitals). Prerequisite: 60.401. 3 cr.

60.421 Auditing

An examination of the purposes of financial and operations auditing. The following topics will be examined in depth: auditing standards, professional ethics, legal responsibilities, internal control, audit evidence, financial statement disclosures, audit reports, management advisory services, and internal auditing. Prerequisite: 60.303. 3 cr.

60.423 Financial Accounting Theory and Practice

An in-depth examination is made of the theory and practice of specific financial accounting topics. Prerequisite: 60.302. 3 cr.

60.431 Federal Income Taxes

Deals with the basic rules and regulations of the Internal Revenue Code as it affects the individual and the corporation. An understanding of the code is developed through lectures, assigned readings, research, and the solution of a wide variety of problems. Prerequisite: 60.202. 3 cr.

60.432 Advanced Federal Taxation

Deals with the rules and regulations of the Internal Revenue Code as it affects corporations, estates and trusts. Emphasis will be on special corporate problems including incorporation, distributions and liquidations. Prerequisite: 60.431. 3 cr.

60.441 Accounting for Not For Profit Institutions

Examines financial accounting methods, principles and systems, as related to state, county and local governments, colleges and universities, and hospitals. While fund accounting concepts provide the general framework of the course, expenditure controls are given particular attention through an examination of appropriation and encumbrance accounting. Prerequisite: 60.302. 3 cr.

60.451 Controllershship

Functions and procedures of the controller in modern business are examined. Emphasis is placed upon control systems which safeguard assets and assist in efficient utilization of the firm's resources. Special attention is placed upon long-range operational planning and control. Prerequisite: 60.302. 3 cr.

60.499 Research Seminar

Designed for upperclass accounting majors who wish to do research and/or investigate special topics of interest in accounting. Prerequisite: permission of instructor. 3 cr.

Department of Management

Professors: Michael H. Best,
Gerald F. Downey,

Stuart C. Freedman, Braxton Hinchey,
Timun L. Kainen, M. Riaz Khan, David A. Lewis, Stuart L. Mandell (Emeritus),
James P. Monahan, Santo J. Pullara (Emeritus), Yash R. Puri, Irwin A. Shapiro (Emeritus)

Associate Professors: Clare L. Comm,
Brooke Hargreaves-Heald, Valerie Kijewski, Sangphill Kim, Goang-Tzer Liaw,
Efrem Mallach, Joyce Mehring, Martin R. Moser, Luvai F. Motiwalla, Leo L. Pipino,
Eunsang Yoon, Louis Yelle (Emeritus)

The Department of Management offers four concentrations within the Bachelor of Science in Business Administration: Finance, Management, Management Information Systems, and Marketing.

Finance Concentration

(Bachelor of Science in Business Administration)

The finance concentration is designed to provide students with a strong background in the fundamental concepts of finance, as well as intensive application of financial problem solving and decision making techniques to a broad spectrum of private and public enterprises operating in domestic and multinational environments. The objective of the finance program is to prepare students for a wide variety of positions in financial management, banking, and the securities field. Courses for the general finance track follow. Tracks in Corporate Finance and Financial Markets are also available. Information on the additional tracks are available in the Dean's office.

Course of Study for Business Administration**Finance Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3

92.121	Management Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Management Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, Science	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

61.301	Business Finance	3
66.301	Organizational Behavior	3
60.331	Cost Mgmt Systems	3
63.371	Operations Mgmt	3
	Elective, non-COM	3
		15

Spring Semester

61.303	Methods of Fin Analysis	3
61.300	Intro to Investments	3
63.301	Management Info Sys	3
	Elective, Aesthetics	3

Elective, COM	3
	15

Senior Year**Fall Semester**

61.431 Capital Planning	3
Elective, COM	3
Elective, Values	3
Elective, non-COM	3
Elective, Literature	3
	15

Spring Semester

61.491 International Finance	3
66.490 Strategic Management	3
Elective, COM	3
Elective, COM	3
Elective, COM or non-COM	3
	15

Management Concentration

(Bachelor of Science in Business Administration)

American management in the 1990's and beyond will continue to face significant change in the internal and external business environment. Rapid technological innovation, increasing international competitiveness, a more diverse labor force, and employees who increasingly expect a high quality work life represent only some of those changes that directly affect the health and vitality of our economy.

The purpose of the management concentration is to produce skilled managers able to perform effectively under these conditions and contribute to economic development. The program's goal is also to develop creative leaders for management positions who have strong behavioral skills and an integrated, problem-centered approach to decision making, and who will act in accordance with society's values and ethical standards. Our strategy is to offer a high quality academic program that will prepare graduates for a rapidly changing regional, national, and global environment.

We emphasize in our curriculum the development of skills needed to a) accurately assess current and emerging business con-

ditions, and b) create new, more flexible, organizational forms and work systems that foster effective, high quality performance in manufacturing and other sectors of the economy. This emphasis will teach students how both jobs and organizations can be designed and managed in ways that "fit" external conditions and encourage employee creativity and successful exploitation of new business opportunities.

Course of Study for Business Administration

Management Concentration
(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101 College Writing I	3
47.101 General Psychology	3
92.121 Management Precalculus (or non-COM)	3
46. Elective, Political Science	3
Elective, Science w/ Lab	4
	16

Spring Semester

42.102 College Writing II	3
48.101 Sociology	3
92.122 Management Calculus	3
43. Elective, History	3
Elect, non-COM Global	3
	15

Sophomore Year**Fall Semester**

60.201 Accounting/Financial	3
49.211 Statistics	3
49.201 Economics I	3
Elective, Science	3
Elective, non-COM	3
	15

Spring Semester

60.202 Accounting/Managerial	3
62.201 Marketing Principles	3
49.202 Economics II	3
63.210 Operations Analysis	3

Elective, Science w/ lab	4
	16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

66.301 Organizational Behavior	3
61.301 Business Finance	3
63.371 Operations Mgmt	3
60.331 Cost Mgmt Systems	3
Elective, non-COM	3
	15

Spring Semester

66.310 Human Resource Mgmt	3
63.301 Mgmt Info Systems	3
Elective, non-COM	3
Elective, COM or non-COM	3
Elective, Aesthetics	3
	15

Senior Year**Fall Semester**

66.410 Neg. Strat. and Processes	3
66.445 Contemp. Mgmt. Devel.	3
Elective, COM	3
Elective, COM	3
Elective, Literature	3
	15

Spring Semester

66.420 Leadership Processes	3
66.490 Strategic Management	3
Elective, COM	3
Elective, COM	3
Elective, Values	3
	15

Management Information Systems Concentration

(Bachelor of Science in Business Administration)

The Management Information Systems concentration (MIS) exposes students to the application of computer-oriented systems techniques and concepts applicable to a wide variety of business problems. Students are trained to help select, use, and manage the ever changing information resources of the firm.

Course of Study for Business Administration**Management Information Systems Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Management Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Management Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, Science	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3

49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

60.331	Cost Management Systems	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
63.301	Mgmt Info Systems	3
	Elective, non-COM	3
		15

Spring Semester

63.307	Systems Anal & Design	3
63.371	Operations Mgmt I	3
	Elective, COM or non-COM	3
	Elective, Values	3
	Elective, Aesthetics	3
		15

Senior Year**Fall Semester**

63.	Elective, MIS	3
	MIS Elective (Programming)	3
63.404	Telecom. and Networking	3
	Elective, Literature	3
	Elective, COM	3
		15

Spring Semester

63.403	Database/Comm Mgmt	3
66.490	Strategic Management	3
	Elective, COM	3
	Elective, COM	3
	Elective, non-COM	3
		15

Marketing Concentration

(Bachelor of Science in Business Administration)

Marketing is the process whereby organizations anticipate and adapt to environmental change. Accordingly, successful management of the marketing process requires an appreciation for and understanding of buyer behavior, marketing research, product development, distribution and promotional strategies, and pricing policy. Students graduating in marketing often go on to careers in general management, as well as advertising, sales and sales management, retailing, wholesaling, marketing research, physical distribution, purchasing, or marketing management.

The College of Management and the Purchasing Management Association of Boston have developed a program in the area of purchasing. Marketing students who pursue the purchasing track will take the following courses with purchasing internships available on a competitive basis:

Marketing Electives

62.403	Business Marketing
62.406	Purchasing & Materials Mgmt
	Free Electives
63.372	Operations Planning and Control
63.471	Managerial Quality Control

Course of Study for Business Administration**Marketing Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Management Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Management Calculus	3

43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, Science	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

60.331	Cost Management Systems	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
63.371	Operations Mgmt	3
	Elective, non-COM	3
		15

Spring Semester

62.311	Identifying Mkt. Opport.	3
62.312	Marketing Tactics	3
	Elective, COM	3
	Elective, COM	3
	Elective, Aesthetics	3
		15

Senior Year**Fall Semester**

62.313	Sales and Cust. Rel.	3
62.	Elective, Marketing	3
	Elective, COM	3
	Elective, Values	3

Elective, Literature	3
	15

Spring Semester

63.405	Mgmt Info Systems	3
66.490	Strategic Mgmt	3
	Elective, COM or non-COM	3
	Elective, COM	3
	Elective, non-COM	3
		15

Finance, Management, Management Information Systems, and Marketing course descriptions.

Finance (Course Prefix: 61)**61.300 Investments**

Introduction to the principles of investment. Security analysis of stocks and bonds for markets, industries and firms. Primary and secondary capital markets, money markets, and other investment alternatives in terms of risk-return trade-offs. Options and futures as investment alternatives. Emphasis is on fundamental and technical analyses. Prerequisite: 60.201. 3 cr.

61.301 Business Finance

Principles of financial management, including working and fixed capital, sources of funds, financial statements, financial planning and capital structure. Prerequisite: 49.202 and junior standing. 3 cr.

61.302 Money and Banking

Evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System. Structure and function of the commercial banking system and the role of other financial institutions. Prerequisite: 49.202. 3 cr.

61.303 Methods of Financial Analysis

The techniques of financial analysis in depth. Topics covered include cash management, credit scoring, receivables monitoring, inventory management, financial statements analysis and forecasting, financial distress prediction, mergers and acquisitions techniques and other selected topics. Prerequisite: 61.301. 3 cr.

61.411 Financial Institutions and Markets

Theoretical and pragmatic aspects of the financial process in the economic system. Analysis of financial intermediation. Prerequisite: 61.302. 3 cr.

61.421 Portfolio and Security Analysis

Advanced course on investment theory and applications. Topics covered include stock market behavior, portfolio and capital market theories, and securities analysis. Prerequisite: 61.300. 3 cr.

61.431 Capital Planning

Advanced study of the principles. Emphasis on case analysis and problem solving. Prerequisite: 61.303. 3 cr.

61.432 Advanced Financial Management

Seminar on current topics in finance. Advanced journal readings, computer assignments, and a term project are emphasized. Prerequisite: 61.431. 3 cr.

61.491 International Finance

Financial aspects of international business operations. Evaluation of risks associated with multinational operation and managerial decision making under conditions of financial uncertainty. Prerequisite: 61.301. 3 cr.

61.492 Financial Strategy and Technology

Analysis of the innovation/technology diffusion process. The role of finance concepts and theory in technology adoption and the management of technological change. Prerequisite: 61.432. 3 cr.

61.499 Independent Study in Finance**Marketing (Course Prefix: 62)****62.201 Marketing Principles**

The role of marketing in the economy. The elements of the marketing mix - product, price, distribution, and promotion - are discussed in the context of social and political constraints on marketing activity. Prerequisite: 49.201. 3 cr.

62.302 Marketing Research

Analysis of the information gathering function of marketing management. Design, execution and evaluation of marketing research. Prerequisites: 62.301, 49.212. 3 cr.

62.303 International Marketing

The marketing aspect of international business. Cultural dynamics, economics, political and legal constraints as they affect international marketing institutions and practices. Prerequisite: 62.301. 3 cr.

62.311 Identifying Marketing Opportunities

Focuses on the strategic role of marketing as the functions which leads the business to new products and new markets. Emphasis on market development and product development.

62.312 Marketing Tactics

Focuses on tactical process of managing the marketing mix. Emphasis on market penetration. Term project: marketing plan. Career relevance: understand the role of the marketing communications specialist, appreciate sales and service support activities.

62.313 Sales and Customer Relations

Focuses on day-to-day operating decisions in sales, customer service, and account management. Professional selling and sales forecasting. Term projects; Selling exercise, marketing audit. Career relevance: develop understanding of professional selling, retail and wholesale operations, purchasing, and logistics.

62.401 Marketing Communications

Evaluation of various marketing communication methods, including sales promotion and public relations, with an emphasis on advertising. Research, copy writing, scheduling and budgeting from the viewpoint of the marketing manager. Prerequisites: 62.302, 62.303. 3 cr.

62.402 Buyer Behavior

Applications of behavioral theories and techniques to the understanding of consumer and organizational purchasing processes. Prerequisites: 47.101, 48.101, 62.302, 62.303. 3 cr.

62.403 Business Marketing

Special problems in marketing industrial goods. Distribution channels, pricing policies, product line planning and promotional strategy for companies marketing to industrial firms, governmental agencies and other organizations. Prerequisites: 62.302, 62.303. 3 cr.

62.404 Physical Distribution Management

Social and economic aspects of trans-

portation problems as revealed by analysis of the nature, history, and problems of the American transportation industry.

Management of the distribution function: warehousing, inventory control, material handling and industrial packaging. Prerequisites: 66.371, 62.302. 3 cr.

62.405 Sales Management

Management of the personal selling function. Principles of sales force organization, selection, training, compensation, supervision and motivation are explored via appropriate cases. Prerequisites: 62.302, 62.303. 3 cr.

62.406 Purchasing and Materials Management

Purchasing procedures, inventory control, quality control, source selection, forward buying and speculation for the production enterprise. Prerequisites: 62.302, 62.303. 3 cr.

62.407 Retailing

Development, organization and management of various types of retailing institutions. Evaluation of retail locations and contemporary retailing problems. Prerequisites: 62.302, 62.303. 3 cr.

62.408 Product Management

Evaluation of the issues, strategies, and tasks that must be planned and managed when developing and marketing new.

62.409 Marketing Models

Examination of quantitative and qualitative models in marketing decision making. Use of computer spreadsheets to build simple models for solving marketing problems. Prerequisites: 62.302, 62.303. 3 cr.

62.423 Marketing Strategy

Formulation, implementation and control of the firm's marketing strategies and plans. Case study of the behavioral, quantitative and environmental aspects of marketing decision-making. Prerequisite: graduating senior standing. 3 cr.

62.494 Foreign Area Analysis

Directed study in acquisition of in-depth knowledge of culture, economic and business conditions, data sources, etc., for a selected region or country. Prerequisites: graduating COM senior, permission of instructor. 3 cr.

62.496 Special Topics in Marketing

Senior seminar covering marketing topics not typically addressed in regularly sched-

uled courses. Prerequisites: 62.302, 62.303, permission of instructor. 3 cr.

62.498 Multinational Business Policy

Integration of knowledge from the various functional areas of business administration toward solution of problems affecting the character and success of the total enterprise. Point of view of the chief executive officer operating in an international setting. (Equivalent to 66.490) Prerequisite: graduating COM senior. 3 cr.

62.499 Marketing Internship

Specific projects undertaken by senior marketing students under joint supervision of department internship coordinator and representative from the business organization hosting the internship. Enrollment restricted to marketing seniors selected by internship coordinator. P/NC (free elective credit) only. 3 cr.

Manufacturing/Management Information Systems**(Course Prefix: 63)****63.201 Computer Technology & Business Applications**

An introduction to the processing of information by microcomputers. Topics include: computer logic, memory, input/output, and use of applications software including spreadsheets, graphics, and data bases. 3 cr.

63.210 Operations Analysis Techniques

This course introduces students to quantitative methods for analyzing business problems. Analytic methods include decision analysis, linear programming, queuing and simulation. Applications address issues in areas such as marketing, production, finance, and logistics.

63.301 Management Information Systems

Structure and foundations of information systems for management from both a users and designers perspective. Prerequisite: 63.201 or comparable computer experience. 3 cr.

63.307 Systems Analysis and Design

Study of existing system requirements and design of modifications or a new system. Includes project for actual or hypothetical application. Prerequisite: 63.301. 3 cr.

63.371 Operations Management

Principles of production/operations management. Nature and function of production systems; operational planning and control; plant layout; materials handling, inventory and quality control. Prerequisite: 63.210. 3 cr.

63.372 Operations Planning and Control

Cases on the application of principles from 66.371 to problems involving continuous, intermittent and job lot production systems for both small and large firms. Prerequisite: 66.371. 3 cr.

63.403 DataBase Management and Communication

A two part course addressing major topics in Data Base Management Systems and Data Communications. DBMS topics include discussions of the major models and associated systems, query languages, and the logical and physical design of a data base. Data Communication topics include basic concepts of point-to-point communication, networks, standards, and management issues. Prerequisites: 63.301, 63.307. 3 cr.

63.404 Business Telecommunications and Networks

This course provides a comprehensive overview in the domain of Business Data Communications and Networking. Information is a critical ingredient for the operation of any organization, and information systems play a vital and increasingly strategic role in the production, management, creative marketing, and delivery of financial services today. This course explores the components of telecommunications in organizations, including how they are used, developed, and managed.

63.406 Decision Support Systems

Study of computer-based information systems that combine the modeling and data retrieval capabilities of the computer to support nonstructured problem solving. Course will present theory and an opportunity to build a working decision support system. Prerequisites: 63.301, 63.307. 3 cr.

63.408 Special Topics in Information Systems

Addresses one or more current topics of importance to the field of Information Systems. Topics can change at each course offering. Typically, the course will focus on an emerging information technol-

ogy, discussing fundamental concepts and the technology's application to and effect on business. Examples of possible topics are expert systems, hypermedia and hypertext systems, factory automation systems, and the planning for and management of information resources. 3 cr.

63.471 Managerial Quality Control

Views quality control from the total or company-wide perspective. It contains traditional material on statistical process control (SPC), quality cost, quality assurance, quality information systems as well as the recent management theories and ideas of Deming, Jurand, Ishikawa and Taguchi. 3 cr.

63.474 Cases in Operations Analysis

Application of techniques from operations research operations to cases in management decision making including scheduling, inventory control and facilities design. Prerequisites: 63.473 or 92.381, 92.242. 3 cr.

63.499 Independent Study in Operations Management**Management (Course Prefix: 66)****66.301 Organizational Behavior**

Examination of individuals, groups and organizations from a behavioral and structural perspective. Topics include employee motivation and satisfaction, work group dynamics and processes, conflict management, and organizational structure and design. Prerequisite: junior standing. 3 cr.

66.310 Human Resources Management

Current issues in the management of human resources. Recruitment, selection work force training and development. Managing reward systems, employee health and safety, performance evaluation and human resource planning. Prerequisite: 66.301. 3 cr.

66.315 Organization Development

Planned organizational change using the theory and technology of applied behavioral science. Intervention strategies at the individual, group and organizational levels are explored. Prerequisite: 66.301. 3 cr.

66.320 Business Research Methods

Examination of various research tools applicable to problems in human resources management and other management disciplines. Credit not given for stu-

dents who have taken 62.302.

Prerequisites: 66.301 and 49.212. 3 cr.

66.410 Negotiation Strategies and Processes

The ability to recognize situations that require influence skills does not necessarily produce the skills to deal with it successfully. Negotiation is a complex human activity, involving dynamic interpersonal processes. It requires the intellectual ability to understand the key factors that shape and characterize different negotiation situations; the analytical skill to diagnose potential areas of difference and select appropriate strategies to address them; the interpersonal skills to tactically manage the specific communication and decision-making behaviors during the actual bargaining; and the ability to recognize how one's own personality, value system and perceptions affect the choice of tactics and behavior. Prerequisite: 66.301. 3 cr.

66.415 Work System Design

Examination of a wide array of alternative work arrangements, including those developed in other societies and cultures. Issues in flexible job design and employee participation in planning and decision making are addressed. Develops a framework for analysis, guidelines for successful implementation, and a foundation for the successful management of various work systems. Prerequisite: 66.301. 3 cr.

66.420 Leadership Processes

Examines leadership as a dynamic influence process in organizations. The role of leader characteristics and styles; matching leadership behavior and situations; issues in participation; conditions for leadership effectiveness. Prerequisite: 66.301. 3 cr.

66.425 Labor-Management Relations

An examination of current and emerging issues in labor-management relations in manufacturing and other settings. Unions and collective bargaining arbitration, grievance procedures, negotiation processes, and implementation of labor agreements are addressed. Prerequisite: 66.301. 3 cr.

66.430 Compensation Management

Examination of theories and approaches relevant to the design and implementation of monetary and non-monetary reward systems in manufacturing and service organizations. Topics include job analysis

and evaluation, pay structures, salary surveys, pay for performance, and compensation administration. Prerequisite: 66.301. 3 cr.

66.435 Comparative Management

A comparison of management concepts, systems and practices in different societies, and institutional settings. The impact of economic, social, political, and cultural variables on management styles, processes and organizational structures. Prerequisite: 66.301. 3 cr.

66.440 International Business

Special problems of overseas operations of American firms. Financial, marketing, human resource, and legal problems of the multinational enterprise. State trading, economic integration and international regulatory agencies. Prerequisites: 49.202, 61.301, 62.301, 63.371 and 66.301. 3 cr.

66.480 Current Topics in Management

Topics of current interest in management. Subject matter to be announced in advance. Prerequisite: 66.301. 3 cr.

66.490 Strategic Management

An integration of knowledge in the various functional areas of management toward solution of problems affecting the character and success of the total enterprise. Corporate strategy and its implementation via appropriate policies. Prerequisites: 96 credits and 61.301, 62.301, 63.372 and 66.301. 3 cr.

66.499 Independent Study in Management

An opportunity for the student to carry out individualized study relating to the field of management under the supervision of a member of the faculty. Prerequisites: Senior standing and permission of the instructor. 3 cr.

College of Management Faculty

Michael Best, Professor; B.A., Central Washington University; M.A., Ph.D., University of Oregon

Clairmont P. Carter, Professor; B.S., Pennsylvania State University; M.B.A., University of Akron; D.B.A., Kent State University.

Samuel Chesler, Associate Professor; B.S., Boston University; M.B.A., Suffolk University.

J. Stephen Collins, Associate Professor; B.A., Boston College; M.S., Northeastern University; Ph.D., Boston College; C.P.A. (Massachusetts).

Clare L. Comm, Associate Professor; B.S., Miami University; M.B.A., University of Dayton; Ph.D., University of Cincinnati.

Gerald F. Downey, Professor; B.S., M.B.A., Northeastern University; M.S., Ph.D., Boston College.

Charles F. Feeney, Professor; B.S., Boston College; M.B.A.,

Northeastern University; C.P.A. (Massachusetts).

Stuart C. Freedman, Professor; B.A., City University of New York; M.S., Ph.D., Cornell University.

John G. Hamer, Associate Professor; B.S., University of Lowell; M.B.A., Ph.D., Texas A & M University.

Brooke D. Hargreaves-Heald, Assistant Professor; B.A., Brandeis University; J.D., Northeastern University.

Braxton Hinchey, Professor; A.B., M.A., Ph.D., University of Missouri.

Timm L. Kainen, Professor; B.A., Connecticut State University; M.A.,

University of Hartford; Ph.D., University of Massachusetts Amherst.

M. Riaz Khan, Professor; B.S., M.S., University of Karachi; M.A., M.B.A., Ph.D., State University of New York at Buffalo.

Valerie Kijewski, Associate Professor; B.A., Boston College; M.A., Ph.D., Indiana University.

Sangphill Kim, Assistant Professor; B.A. Yor-Sei University; M.B.A. University of Santa Clara; Ph.D., Ohio State University.

Linda H. Kistler, Professor; B.S., M.S.,

Colorado State University; C.P.A. (Massachusetts).

David A. Lewis, Professor; B.S.I.E., Northwestern University; M.S.I.E., University of Texas at Arlington; Ph.D., University of Massachusetts Amherst.

Goang-Tzer Liaw, Associate Professor; B.A., National Taiwan University; M.A., University of Minnesota; Ph.D., University of Illinois.

Efrem G. Mallach, Associate Professor; B.S.E., Princeton University; M.B.A., Boston University; Ph.D., Massachusetts Institute of Technology.

Stuart L. Mandell, Commonwealth Professor Emeritus; B.A., Brooklyn College; M.B.A., Syracuse University.

Joyce S. Mehrling, Associate Professor; B.A., Bucknell University; M.S., University of Michigan; Ph.D., Massachusetts Institute of Technology.

James P. Monahan, Professor; B.S., M.B.A., Boston College; Ph.D., Columbia University.

Martin R. Moser, Associate Professor; B.A., City College of New York; M.A., Antioch Graduate School of New England; Ph.D., University of Massachusetts Amherst.

Luvai F. Motiwalla, Associate Professor; BComm. University of Bombay, India; B.B.A. Penn State University; M.S. University of Arizona; Ph. D. University of Arizona.

Leo L. Pipino, Associate Professor; B.S.E.E., Manhattan College; M.S.E.E., Northeastern University; Ph.D., University of Massachusetts Amherst.

Norma Powell, Associate Professor; B.S., University of Houston (Clear Lake); M.S., University of Houston; Ph.D., Texas A & M University; C.P.A. (Texas).

Santo J. Pullara, Professor (Emeritus); B.S., M.B.A., J.D., Ph.D., Syracuse University.

Yash R. Puri, Professor; B.Sc., M.Sc., Delhi University; M.B.A., D.B.A., Indiana University.

Irwin A. Shapiro, Professor (Emeritus); B.S., Syracuse University; M.B.A., Indiana University; M.A., Ph.D., Clark University.

Sherre Strickland, Associate Professor;

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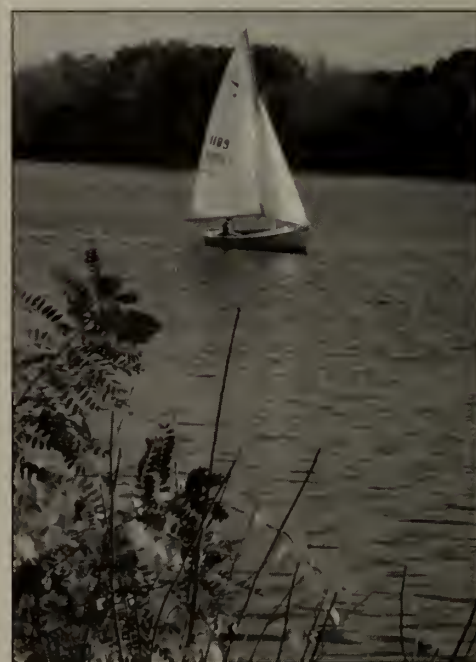
B.B.A., M.B.A., Lamar University; Ph.D., Texas A & M University; C.P.A. (Texas).

Charles F. Thompson, Associate Professor; B.S.A., Bentley College; M.B.A., Northeastern University; C.P.A. (Massachusetts).

Kathryn M. Verreault, Associate Professor; B.S., University of Lowell; M.B.A., Ph.D., Texas A & M University.

Louis E. Yelle, Professor (Emeritus); B.S., Lowell Technological Institute; M.S., M.B.A., Northeastern University.

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Margaret Manion, Engineering/Reference Librarian; B.A., SUNY Albany; M.L.S., Syracuse University; M.S., Northeastern University

Martha Mayo, Special Collections Librarian; B.A., University of Maine, Orono; M.S., University of Illinois, Urbana; M.Ed., University of Massachusetts Lowell

Marion Muskiewicz, Science Technology/Reference Librarian; B.S., Marietta College; M.A., University of Michigan; M.S., University of Lowell

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Patricia Noreau, Periodicals/Series Librarian

Mitchell Shuldman, Media Librarian; B.A., SUNY Cortland; M.S., Simmons College

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Douglas Heifner, Director of Administrative Services; M.B.A., Nichols College; B.B.A., University of Massachusetts Amherst

Peter Kambour, Assistant Director of Plant and Operations; B. S. Massachusetts Institute of Technology

Judy Keyes, Director of Student Financial Assistance; B.S. Franklin Pierce

Dave Kiser, Director of Physical Plant; B.S. Norwich University; M.S. Pennsylvania State University

Mark D. Malkasian, Director of Facilities Planning and Development; B.S., Northeastern University; M.E., University of Florida

Cecile Paquin, Manager of General Accounting

John Perroni, Assistant Comptroller and Director of Treasury Services; B.S., Villanova

James W. Rowe, Sr., Director of Public Safety; B.S., St. Anselm College; M.P.A., Golden Gate University

Diane McLaughlin, Director of Accounts Receivable; B.S. University of Lowell; MBA, University of Massachusetts Lowell

M. Jeannie Tremblay, Director of Purchasing; B.S., University of Massachusetts Lowell

Raymond A. Vigeant, Director of University Telecommunications; B.S., Wentworth Institute; M.S., Northeastern University

George Zaharoolis, Director of Accounts Payable and Receivable

Fran Zannoni, Coordinator of Payroll

Office of Student Services

Ellen C. Duggan, Dean of Students; A.B., M.Ed., Rivier College

Kristen Amman, Assistant Director of Career Services; B.S., M.Ed., University of Massachusetts Lowell

John Bayliss, College Counselor and Staff Psychologist; B.A., M.A., San Francisco State University; M.A., Goddard College; Ph.D., Columbia Pacific University

John E. Burke, Associate Director of Career Services; B.S.B.A., M.A., University of Massachusetts Lowell

Noel Cartwright, Director of Counseling and Career Development; A.B., University of Queensland; S.T.M., Ph.D., Boston University

Annie Ciaraldi, Associate Director of Residence Life; B.A., M.Ed., Plymouth State College

Mary Connelly, Director of Student

Activities, Commuter Services, and Student Centers; B.A., University of R.I.; M.S., Central Connecticut State University

Elizabeth Donaghey, Director of Disability Services; B.A., M.Ed., University of Massachusetts Lowell

Eleanor Ellis, R.N.C.S., F.N.P., Nurse Practitioner; B.S.N., St. Anselm College; M.S., University of Massachusetts Lowell;

Certified by the American Nurses Association

Brenda Evans, Associate Director of Student Activities, Commuter Services, and Student Centers; B.A., M.A., University of Massachusetts Lowell

Elyse Lemaire, Staff Psychologist; B.A., University of Virginia; M.A., University of Florida; Ph.D., University of Florida

Mark D. Levine, Director of Community Services; A.B., Brandeis University; M.S., City College of New York; Ph.D., Union Institute

Nancy Quattrocchi, R.N.C.S., Director of University Health Services; B.S., Boston College; M.S., University of Lowell; Certified by the American Nurses Association

Lanette Crews Scott, College Counselor; A.B., Fisk University; M.A., Northeastern University; Ed.D., University of Massachusetts at Amherst

Chandrika Sharma, Assistant Director of Disability Services; B.A., India, M.Ed., Keene State College; Ed.D., University of Massachusetts Lowell

Larry Siegel, Director of Residence Life and Student Development; B.S.W., SUNY at Stonybrook; M.Ed, Bowling Green State University

Thomas C. Taylor, Assistant Dean of Students; A.B., Colorado College; M.C.M., Denver Seminary

Rhoda Treitsch, Associate Director of Counseling; A.B., Douglass College; M.Ed., Rutgers University

Thomas Winston, Associate Director of Residence Life for Facilities and Operations; BSBA, University of Massachusetts Lowell, M.A., Fairfield University

Patricia Yates, Director of Career Services; B.A., UMass Amherst; MBA, Babson

Office of the Vice Chancellor for University Relations and Development

Frederick P. Sperounis, Vice Chancellor for University Relations and Development; B.S., Salem State College; M.A., Ph.D., Brandeis University

Christine McKenna, Executive Director of Communications and Marketing; B.A. Boston State College, M.P.A., University of Massachusetts Boston

Diana Prideaux-Brune, Special Assistant for Economic Development; B.S. in Architecture, University of Virginia; M.A. in Historic Preservation Planning, Cornell University

Donald G. Rizzo, Executive Director, University Advancement; B.A., Tarkio College; M.S., Bradley University

All correspondence concerning the University of Massachusetts Lowell should be addressed to the appropriate office:

University of Massachusetts Lowell
One University Avenue
Lowell, MA 01854-2881

Academic Records and Transcripts

Ms. Janet King
Registrar
978 934-2555
Janet_King@uml.edu

Student Services

Ms. Ellen Duggan
Dean of Students
978 934-2100
Ellen_Duggan@uml.edu

Academic Services

Ms. Sheila Riley-Callahan
Director of Academic Services
978 934-2946
Sheila_Riley@uml.edu

Admissions

Dr. Lisa Johnson
Assistant Vice Chancellor for
Enrollment Management
978 934-3944 or 1 800 410-4607
Lisa_Johnson@uml.edu

Veterans' Benefits

Ms. Peggy McNamara
Office of the Registrar
978 934-2556
Margaret_McNamara@uml.edu

Transfer Admissions

Mr. Gerald Durkin
Director of Transfer Admissions
978 934-3942 or 1 800 410-4607
Gerald_Durkin@uml.edu

Financial Aid

Ms. Judy Keyes
Director of Financial Assistance
978 934-4232
Judy_Keyes@uml.edu

Residence Halls

Mr. Larry Siegel
Director of Residence Life
978 934-2107
Laurence_Siegel@uml.edu

Career Services

Ms. Patricia Yates
Director of Career Services
978 934-2355
Patricia_Yates@uml.edu

Counseling Services

Dr. Noel Cartwright
Director of Counseling
978 934-4331
Noel_Cartwright@uml.edu

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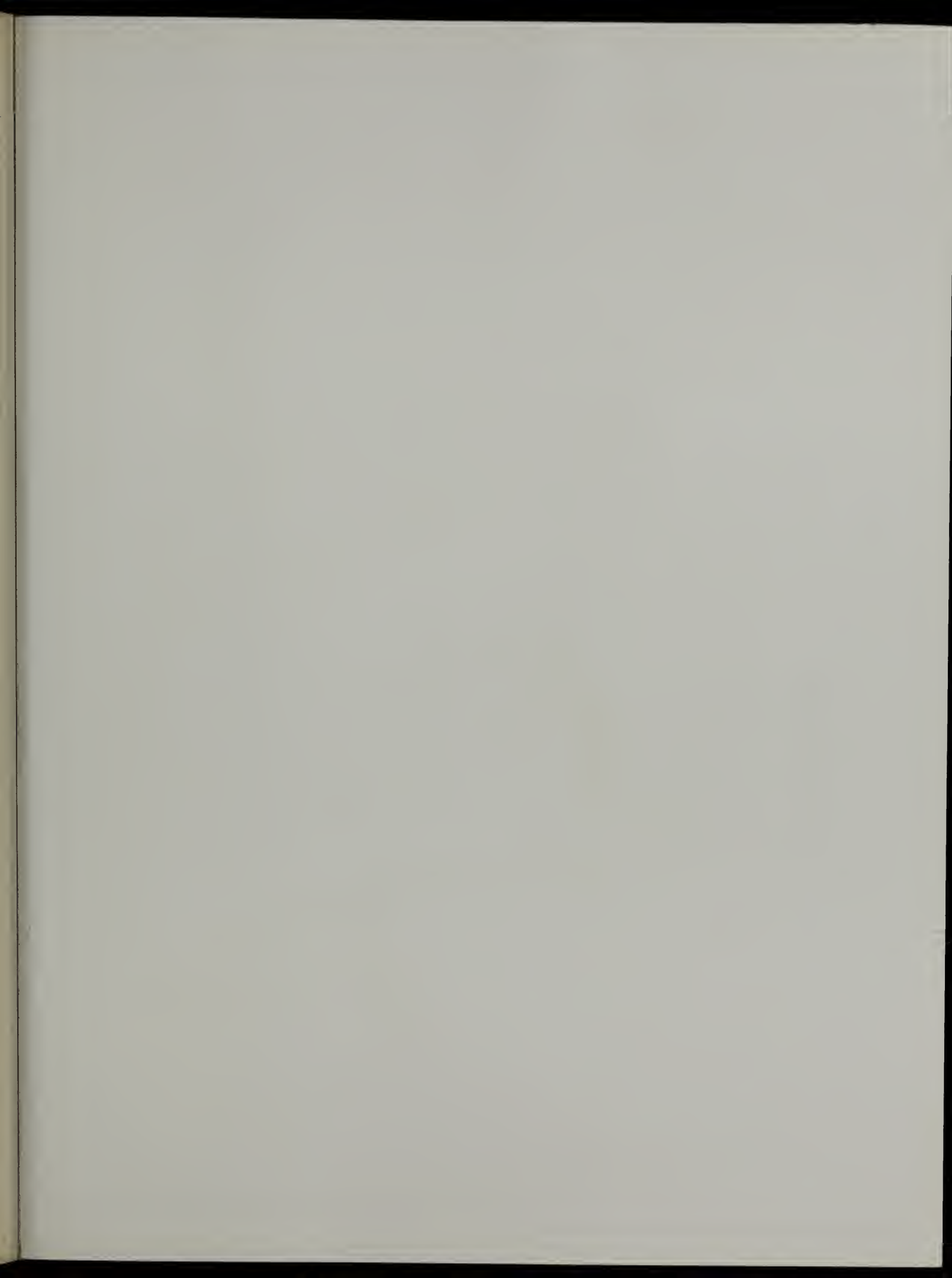
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UMASS Lowell

One University Avenue
Lowell, Massachusetts
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